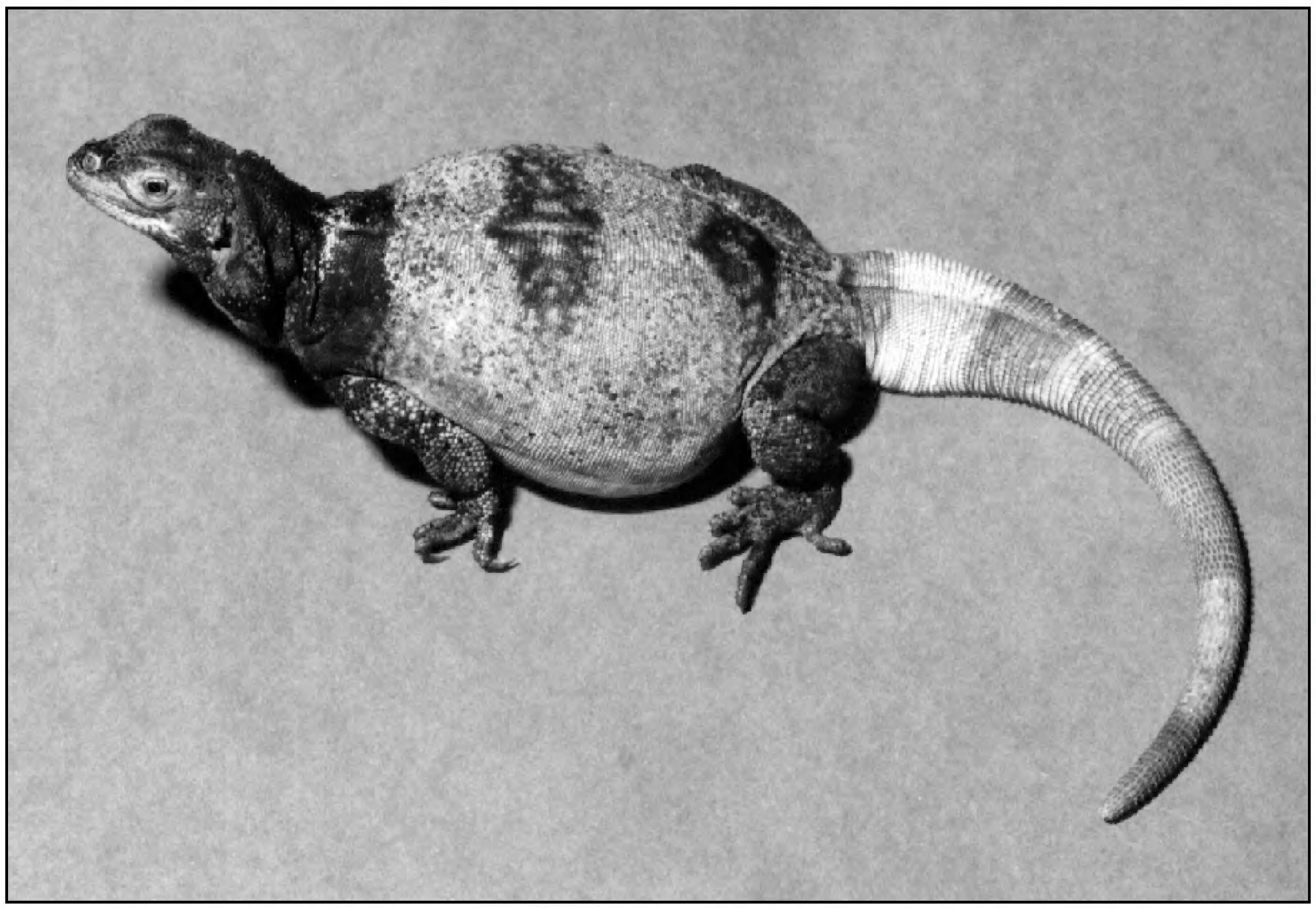
BULLETIN
of the
Chicago Herpetological Society

Volume 32, Number 6
June 1997



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The BULLETIN of the Chicago Herpetological Society (ISSN 0009-3564) is published monthly by the Chicago Herpetological Society.

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Bull. Chicago Herp. Soc. 32(6):121-137, 1997

Captive Management, Behavior and Conservation of Chuckwallas, *Sauromalus obesus* (Lacertilia: Iguanidae)

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The common chuckwalla, *Sauromalus obesus*, is a large, herbivorous iguanid lizard that inhabits rocky terrain in the Mojave and Sonoran Deserts of the southwestern United States and northern Mexico. Little information has been published on the captive maintenance of this species; three articles (Hunziker, 1996; Schiberna, 1995; Crooks, 1983) deal with *S. obesus*, although Blair (1994a) discussed the general care of all *Sauromalus* species. Due to their threatened status, the giant insular chuckwallas, *Sauromalus hispidus* and *S. varius*, have received more attention than *S. obesus* with regard to captive management and reproduction (Carl and Jones, 1979; Sylber, 1985 a,b; Lawler, 1982, 1994; Lawler and Jarchow, 1986; Lawler et al., 1994). My study of the captive management of *S. obesus* began in 1992, with the acquisition of an immature pair from California. Subsequently, through gifts, loans and collecting trips, I acquired an additional ten lizards which were kept for varying periods of time for this research. A total of 32 chuckwallas (captives in other collections or field collected and released) was also examined and/or photographed. General information is presented on the proper care of common chuckwallas and the minimum requirements needed to breed them successfully. Critically important information on various aspects of the natural history of a species can be obtained through observations of captive specimens (Lawler and Jarchow, 1986). Herein I describe some aspects of their reproductive biology and behavior that have not been reported previously. My observations are presented in the context of our knowledge of these lizards in nature. This information should be useful to herpetoculturists and to academic researchers who may need to maintain these lizards for long-term studies.

Housing

Sauromalus obesus is a relatively large lizard, reaching a maximum snout–vent length of 215 mm (Hollingsworth, 1995), and thus requires a spacious cage. Howard Lawler (pers. com.) suggests floor space of at least 122 × 61 cm for an adult pair of chuckwallas. My lizards are kept as pairs (or a male and two females) in cages 154 cm × 69.5 cm × 56.5 cm, constructed from ¾-inch (18 mm) plywood, with a glass front. All wood surfaces of the cage are coated with a light-colored, waterproof, enamel paint. All corners and joints between walls and glass are sealed with silicon sealant to prevent the lizards' toes from being snagged in small cracks. The cage top consists of ¼-inch (6 mm) hardware cloth attached to a wood frame mounted onto the cage with hinges; this design provides adequate ventilation and prevents the buildup of high humidity.

Thermal and Light Environments

Thermoregulation in chuckwallas has been investigated extensively under both field and laboratory conditions (Case, 1976b; Crawford and Kampe, 1971; Firth et al., 1989; Johnson, 1965; McGinnis and Falkenstein, 1971; Muchlinski et al., 1989, 1990; Zimmerman and Tracy, 1988, 1989).

Muchlinski et al. (1990) measured, by radiotelemetry, the mean selected body temperatures (MSBT) of 15 chuckwallas on 26 animal days. During the period of activity, the MSBT ranged from 37.3 to 39.8°C ($\bar{x}$ = 38.8°C), while the MSBT from the time lizards attained their first high set point to the time of sunset ranged from 36.1 to 39.6°C ($\bar{x}$ = 38.3°C). These values were 2.4 to 2.9°C higher than mean values obtained by McGinnis and Falkenstein (1971), and slightly higher than the temperature preferences reported by Zimmerman and Tracy (1989). The mean temperature selected by captive chuckwallas year-round in a thermal gradient was 37°C (Case, 1976b). The body temperatures of 70 free-living chuckwallas recorded by Johnson (1965) ranged from 25.8 to 41.9°C ($\bar{x}$ = 35.3°C). The data of Muchlinski et al. (1990) are probably more accurate than measurements taken by previous researchers because they were obtained from undisturbed chuckwallas in their natural environment. Muchlinski et al. (1990) surmised that the lower mean value obtained by Johnson (op. cit.) was probably due to the inclusion of early morning basking chuckwallas. Johnson found that chuckwallas were active at body temperatures between 18 and 39°C. The maximum body temperature of an undisturbed lizard recorded by Muchlinski et al. (1990) was 42.9°C, whereas Case (1976b) obtained a maximum of 46°C from a captured animal, a value close to the critical thermal maximum of 46.7°C obtained by Cowles and Bogert (1944).

Based on the foregoing information on chuckwalla thermoregulation, I arranged incandescent lights in my cages to provide light as well as "hot" and "cool" areas; photoperiod was regulated by electrical timers that were manually adjusted following a photoperiodic chart for Clemson, South Carolina. Thermal gradients are an essential component of the cage environment, allowing lizards to seek appropriate temperatures based on metabolic and other physiological needs. Initially, each cage was heated by one 75 w and two 150 w indoor floodlights placed between 23 and 30 cm above the substrate. Subsequently, I determined that one 150 w and one 75 w lamp were adequate for the hot and cool areas, respectively. When necessary, ambient temperatures could be elevated by partly covering the screen top with polyethylene plastic sheets. During the early spring, cool areas in the cage registered 24°C, whereas basking sites directly under the 150 w lamps were in excess of 50°C. Later in the summer, cool areas often registered 29 to 30°C due to a general rise in the ambient room temperature. Nighttime cage temperatures dropped as low as 18°C during the active season.

Floodlights rather than spotlights are preferred since the

heat is more evenly dispersed over a relatively large surface of the basking area. Spotlights tend to concentrate intense heat in a small area with the potential of causing thermal injuries. In this respect, they are similar to a malfunctioning "hot-rock." Since chuckwallas are diurnal, heliophilic lizards, the use of under-tank heat pads, tapes or "hot-rocks" is not recommended (Hunziker, 1996; this study).

My lizards have been maintained and reared successfully without full-spectrum lighting. Vitamin D_3, which is necessary for proper calcium absorption, is supplied through dietary supplementation (see Nutrition). The hypothesis that full-spectrum lighting is important for the "psychological well-being" of the lizards is not supported by my observations. The chuckwallas consistently exhibit a relatively normal range of behaviors (courtship, copulation, oviposition, aggression and hibernation) under incandescent lighting. However, Moehn (1974) noted behavioral changes (increased assertion displays and agonistic behaviors) in *Dipsosaurus*, *Crotaphytus* and *Agama* induced by ultraviolet light.

Furthermore, Alberts (1989) demonstrated the importance of ultraviolet light for successful detection of femoral gland deposits in *Dipsosaurus dorsalis*.

Structural Environment

The cage substrate consists of fine (screened), washed, heat-sterilized river sand. While a coarse gravel could be used, there is a risk that if ingested by hatchling chuckwallas, the larger bits of rock could block the intestine (usually at the pyloric sphincter), causing death. Sylber (1985a) reported this problem with hatchlings of the giant insular species, but noted that adults normally ingest and pass gravel through the intestine. Newspaper can also be used as a substrate, but it is less absorptive than sand and is a poor surface for traction. Some hobbyists also use corrugated paper or alfalfa pellets as substrate materials for chuckwallas and other iguanids, and these appear to be satisfactory.

In nature, chuckwallas are usually associated with rocky habitat, and therefore rocks should be provided in captivity. The cage environment should offer adequate shelter and basking sites, and yet be sufficiently simple to allow easy cage cleaning as well as unhampered movement of the lizards. Squarish rocks with a thickness of 5 to 8 cm are more stable than rounded rocks and can be stacked for basking sites. They can also be used to lean large flat rocks to create shelters. Inclined rocks produce crevices of diminishing diameter, into which chuckwallas can wedge themselves when retreating. Rock stacks should be glued together to prevent possible shifting and injury to the lizards (Hunziker, 1996; Blair, 1994a; this study). Also, all rocks that are inclined or at the bottom of a stack must be in firm contact with the cage floor below the substrate. This will prevent rock movement should a chuckwalla try to dig under such stacks. Dried wood or skeletal stems of cholla cactus (*Opuntia*) are additional esthetic components of the cage environment. Live plants, especially spined cacti, are not safe or practical in the cage.

Nutrition

Chuckwallas feed on a wide variety of desert annual and perennial plants. Nagy (1973) recorded 22 plant species in the diet of *Sauromalus obesus*. Sylber (1988) recorded 35 plant species in the diet of *Sauromalus hispidus* and 22 species eaten by *S. varius*. However, Richard Hansen (in Iverson, 1982) stated that *S. varius* feeds on about 60 genera of plants. Other dietary studies on *Sauromalus* species include: Smits (1985), Nagy (1977), Berry (1974), Hansen (1974), Johnson (1965) and Sanborn (1972). Nagy (1973) reported that annuals comprised about 60% of the diet of *S. obesus* during April and May, but leaves, flowers and seed pods of perennials were eaten later in the season.

Among the food items most readily consumed by captive chuckwallas are: French-style cut green beans, romaine lettuce, endive, escarole, collard greens, mustard greens, bell pepper leaves, dandelion leaves and dandelion flowers. During the spring, chuckwallas are fed dandelion flowers (as available) and a variety of greens. Ensure that dandelions picked from a lawn are not contaminated with herbicides or fertilizers (Hunziker, 1996). Hunziker suggested placing dandelion flowers in the freezer for later use since these plants are seasonal bloomers. He also noted that chuckwallas will eat forsythia blossoms.

In nature, the diet of chuckwallas contains a high percentage of fiber, as evidenced by the composition of fecal pellets collected from basking sites (Blair, 1994a; this study). *Sauromalus hispidus*, *S. obesus* and *S. varius* are known to digest fiber (Voorhees, 1981; Zimmerman and Tracy, 1989:376). In captivity, additional fiber can be supplied by adding alfalfa cubes (rodent diet), pulverized and mixed with other greens. The food is placed on a flat, ceramic dish; the lizards are normally fed daily (or at least five days per week) between 10:00 and 11:00 A.M.; Johnson (1965) noted that in nature, foraging occurs primarily during morning hours. In captivity, the lizards typically show a thermophilic response after feeding, and subsequently ensconce themselves in rock crevices. Later in the day, the lizards may resume activity and feed to a limited extent.

Chuckwallas obtain free water from their food plants and also produce it metabolically. Nagy (1972) studied the water budget of free-living chuckwallas; during early spring, the lizards have a positive water balance because they consume annual plants that contain 2.5 g of free water per gram of dry plant material. But in late May, as the annuals wither, their free water content drops to 0.96 g per gram of dry weight. Nagy discovered that chuckwallas had a net water gain of 0.81 g/day in early May, but a net loss of 0.84 g in late May. About 61 percent of the total water loss of the chuckwalla was by evaporation from the skin and respiratory surfaces, with feces and urine accounting for 31 and eight percent of the loss, respectively. When the lizards stopped feeding and became inactive, the daily water loss was reduced by nearly 90 percent. Seasonal variation in activity as influenced by food supply and thermal ecology is described in detail by Zimmerman and Tracy (1989). In captivity, due to a constant food supply, chuckwallas remain active throughout the summer season.

Norris and Dawson (1964) discovered that chuckwallas uniquely possess accessory lymph sacs extending along the lateral abdominal folds. These sacs enable the lizards to increase their volume of extracellular fluid during favorable times of the year. Chuckwallas collected after long periods of drought invariably have empty sacs, but under favorable captive conditions, the sacs gradually fill to capacity.

The diet of chuckwallas in captivity usually contains more water than is normally obtained in nature. Consequently, captive lizards may void copious amounts of liquid with the feces; this is not observed when wild-caught lizards are first brought into captivity. The water content of the food may be reduced by blotting leafy greens with paper towels, and, for thawed green beans, wrapping them in paper towels and squeezing out as much water as possible. The addition of dried alfalfa shake to the diet is also helpful in reducing the water content of the food. A water dish in the cage is obviously unnecessary and not recommended (Hunziker, 1996), as it can be a source of bacterial proliferation, and a damp environment may possibly promote fungal diseases and necrotic dermatitis. However, Brian Jones (pers. com.) recommends supplying water to female chuckwallas after egg-laying.

There are a number of commercially available vitamin/mineral supplements for reptiles. Osteo-form (VET-A-MIX, Inc., for mammals), a calcium-phosphorus powder (Ca/P ratio of 1.96–1.64 : 1) with Vitamin A, D_3 and C, was used for one year, and during this time, normal health and growth was observed. Presently, I am using a 50:50 mixture of Rep-Cal and Herptivite (Rep-Cal Research Labs, Los Gatos, CA), which is lightly sprinkled over the food (approximately < 1/8 tsp. over two-thirds cup of greens). Supplementation is given daily, and is more liberally supplied to gravid females, which require large amounts of nutrients and calcium to produce eggs. Chuckwallas maintained under this regimen have shown excellent growth (juvenile to adult size), normal bone development, and no evidence of hypercalcemia of the soft tissues over a five-year period. Eggs produced by females have shown normal calcification. In chuckwallas and desert iguanas supplemented three times weekly, I observed initial signs of metabolic bone disease, suggesting that this schedule may be inadequate. Therefore, I recommend daily supplementation as there is a greater risk of hypocalcemia than hypercalcemia under incandescent lighting.

The amount of animal protein normally consumed by chuckwallas in nature appears to be minimal. Howard Lawler (pers. com.) recommended no more than 8 to 10 percent (by dry weight) animal protein in the diet. Frye and Townsend (1993) suggested a 25 percent proportion of insect protein in the diet of *Sauromalus* species, but this is not supported by field studies. Only one insect in the stomachs of 44 chuckwallas was reported by Nagy (1973) during one field season. In 26 chuckwallas, Sanborn (1972) found insects in 12 percent of the stomachs, and their volume was insignificant. He concluded that the small insects (thrips, beetles and bees) were accidentally ingested when whole flowers were eaten. Hansen (1974) noted that the diet of chuckwallas in the Grand Canyon region of Arizona contained 3.9 percent grasshopper nymphs. Shaw (in Johnson, 1965) observed captive *Sauromalus obesus* eating mealworms, and *Sauromalus ater shawi* eating mice. Scott Patterson (pers. com.) stated that his captive *S. obesus* ate green anole lizards. Both captive and free-living chuckwallas will accept hornworms, the larvae of the sphinx moth (Lester Milroy, pers. com.). Schiberna (1995) occasionally fed his chuckwallas small cockroaches and locusts. Mayhew (1963) reported that young chuckwallas fed mealworms show substantial increases in growth rate. He concluded that chuckwallas have the necessary digestive enzymes to utilize this animal protein. Ruppert (1980) compared the dietary assimilation efficiencies of *Sauromalus obesus* and *Crotaphytus bicinctores*. He determined that the chuckwalla was 66.6% efficient on a diet of dandelions, and that both species were equally efficient (60%) on a diet of crickets. Thus, chuckwallas are able to maintain body weight on a diet of insects. He viewed chuckwallas as omnivores in a physiological sense, although ecologically they are herbivores. He speculated that because of large body size, the energetic costs placed upon chuckwallas when capturing animal prey were prohibitive and may have led to the evolution of herbivory. Also, competition with insectivorous lizards may have been a factor.

Chuckwallas in a state of starvation (inanition) can be supplemented with finely chopped hard-boiled eggs and/or "monkey biscuits" (ZuPreem Primate Dry), powdered and sprinkled over the salad. The additional fat and protein from these sources are beneficial and conducive to rapid weight gain. However, after normal weight is restored, the supplementation should be removed from the diet to reduce the risk of visceral gout and egg-binding in these herbivores.

Chuckwallas, and other iguanid lizards, are classified as "hind-gut fermenters," and depend on their colonic bacteria and protozoa and high environmental temperatures to facilitate digestion (Iverson, 1982). Therefore, adequate heat should be available for captive chuckwallas after feeding. Electrical failures and cold weather are potential hazards for these lizards during their active season. Also, chuckwallas should not be transported with food in their stomachs.

Dormancy

Sauromalus obesus normally goes into dormancy during the winter months. Based on studies by Berry (1974) and Johnson (1965), chuckwallas in the Mojave Desert emerge from hibernation in mid- to late February, or as late as mid-March. Chuckwalla abundance begins to subside in June, and by August and September relatively few adults are active. Johnson's study suggested that adults go into aestivation during the late summer and then directly into winter hibernation. Virtually nothing is known about chuckwalla hibernation in nature, what temperatures normally prevail in the hibernaculum, or whether there is any winter activity. However, Berry (op. cit.) reported occasionally finding chuckwallas in rock crevices during the winter months when air and substrate temperatures were below 20°C.

Hibernation is not essential to bring chuckwallas into reproductive condition. Chuckwallas at the Riverbanks Zoo, Columbia, South Carolina, remain active and feed during the winter

months, and have bred every spring since 1992 (Scott Pfaff, pers. com.). The chuckwalla exhibit at the zoo has a skylight and evidently the natural changes in photoperiod are sufficient to stimulate reproduction. My chuckwallas are prepared for dormancy by gradually reducing the photoperiod. Near the end of September food is withheld, and in mid-October the ambient temperature is lowered by removing the plastic covers used to retain heat in the cages. After a couple of weeks (late October/ early November) the floodlights in each cage are turned off. The room in which the cages are kept is unheated so that during the winter months, the ambient nighttime temperatures may range between 8 and 16°C. During midwinter, daytime temperatures occasionally reach 19 to 21°C, and some of my captive chuckwallas may emerge from shelters and sit on basking sites. On these occasions, I switch on the 150 w floodlight to allow the lizards to bask for one and a half hours. Winter temperature minima of 8°C or below over extended periods may be stressful for chuckwallas from the Sonoran Desert. During such cold spells I set electrical timers to turn on one 75 w floodlight, thereby raising ambient temperatures slightly. By March 15, all cage lights are turned on, usually after the first chuckwallas begin to emerge from their shelters. The lizards receive normal heating for about one week before they are fed. Water is offered to juveniles after the first day of activity if they appear dehydrated.

Courtship and Mating

Chuckwalla courtship in nature is quite complex, involving head-bobbing, licking, circling, nudging, jaw-rubbing, and other behaviors; see Berry (1974) for detailed descriptions based on field observations. In contrast, courtship behavior of captive chuckwallas maintained in an outdoor enclosure (Berry, op. cit.:46) or indoors (this study) is more simplified. Captive male chuckwallas begin head-bobbing seven to ten days after emergence from hibernation, and during April and May, the frequency of head-bobbing increases. The male typically follows the female about the cage, often rubbing his vent on the substrate as he circles her and bobs vigorously. The male often licks the female on her head, upper back, legs or rump, usually causing her to jerk and move away. Eventually, there are attempts to copulate. Five attempted copulations involving three pairs of lizards were observed on 18 June 1993; 10, 13 and 30 April 1994; and 22 May 1996. These attempts were rapidly terminated by the nonreceptive female. Two instances were similar in that the female attempted to escape into a rock crevice while the male held the skin of her nape or upper back in his jaws. The male's grip was released after the female struggled and repeatedly slapped him with her tail. In one instance, following release, the female lunged with open mouth at the male. Tail-slapping was also observed when a subadult female was first placed in a cage containing an adult male. The male followed the new female around the cage, repeatedly licking her on the tail, hind legs or lower back. Each instance of licking elicited a vigorous tail-slap. Berry (1974) did not observe tail-slapping by nonreceptive females, nor by males as part of the ritualized combat.

In another case of rejection behavior, a male suddenly grasped a female's nape with his jaws and rode her for about 20 seconds as she ran about the cage in a jerky manner, trying to dislodge him. Her hindquarters were elevated, tail slightly arched, and she jerked her head from side to side. After the male released his grip, the female quickly retreated into a rock crevice. In three cases when a new female was placed in a cage holding an adult male, the male bobbed briefly and then rapidly pursued the female, who quickly sequestered herself in a rock crevice. The male followed and remained close to the female for several hours. Berry (1974:29) was uncertain if the female's tail-arched posture represents a rejection display, but my observations of several females support this idea.

During the period of intense courtship, the male's feeding is greatly reduced or suspended entirely; also, the male may show considerable interest in the fecal droppings of females, lingering when they are encountered and tongue-flicking them repeatedly. I speculate that the male can assess the female's reproductive status by chemical cues in her feces. However, the male's behavioral strategy seems to be to court continually and to attempt to mate until the female accepts him. Female acceptance may be determined as much by her physiological state of readiness as by the male's physical and behavioral attributes. Figure 1 illustrates sexual dimorphism in color pattern and head width.

Prieto and Sorenson (1977) observed four copulations from May through June in chuckwallas from southern Arizona, but specific dates were not given. Berry (1974:44) observed matings in the field on 5, 6 and 8 June, and two more in an outdoor pen on 13 June. Johnson (1965) observed mature males

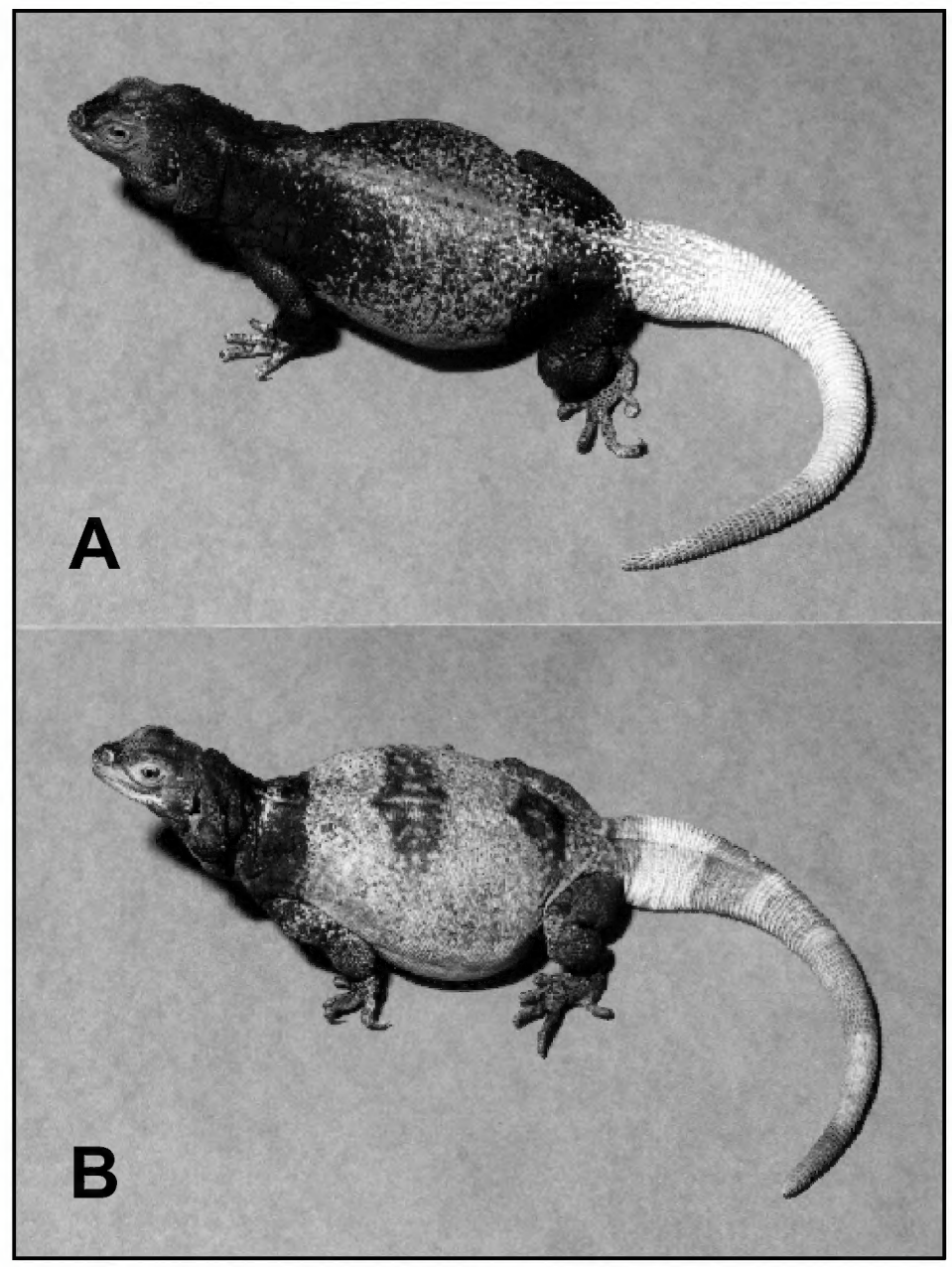

Figure 1. Adult male (A) and adult, gravid female (B) Arizona chuckwallas, *Sauromalus obesus*, showing sexual dimorphism in head shape and color pattern.

and females in pairs in the field between 26 March and 25 June. I observed four copulations; one male mated with the same female twice in the same season: 22 April and 30 April 1995. The other copulations were by two different males on 10 and 19 May 1996. Only one mating was observed in its entirety and timed; the duration was 15 minutes and 22 seconds. The three matings observed in the field by Berry (op. cit.) lasted from 3 minutes and 50 seconds to about 6 minutes, whereas the two copulations in the outdoor pen lasted from 4 to 4½ minutes. In the four copulations noted by Prieto and Sorenson (1977), the male's hemipenis remained inserted a mean of 36 sec (range: 19–59 sec). Schiberna (1995) stated that a copulation in his captive lizards lasted between 2 and 3 minutes.

During copulation, the male uses his jaws to grasp the female by the loose skin on her nape, or by her lateral nuchal fold behind the tympanum, or by her upper back. He curves his tail slightly, using the convex border of the curve to lift the female's tail. A receptive female may raise her tail and hindquarters slightly upon first detecting the male's lifting attempt, thereby facilitating intromission. The male presses his cloacal vent against hers and one hemipenis is everted into her cloaca; it may be partly visible during coitus. One of the male's hind legs straddles the female's lower back, while his forelimbs grasp her sides or the substrate (Figure 2). During copulation, the male's snout jerks laterally in a rhythmic manner at 1–2 second intervals. I have observed this curious behavior in both Mojave Desert and Sonoran Desert males. Schiberna (1995) also reported this behavior in his males (origin unknown), but Berry (1974) and Prieto and Sorenson (1977) did not. The male may retain his bite hold on the female while withdrawing the hemipenis, or release his grip about 20 seconds before ending coitus. As the hemipenis is retracted, the male raises his body off the substrate by extending the legs and holds the tail in an arched curve (Prieto and Sorenson, 1977; this study).

Oviposition and Nesting Behavior

The appetite of a gravid female will gradually diminish as her eggs enlarge and take up additional space in her abdomen. When she is nearly ready to lay eggs, there will be complete loss of appetite and she will dig persistently at the corners of the cage. The time interval between copulation and oviposition

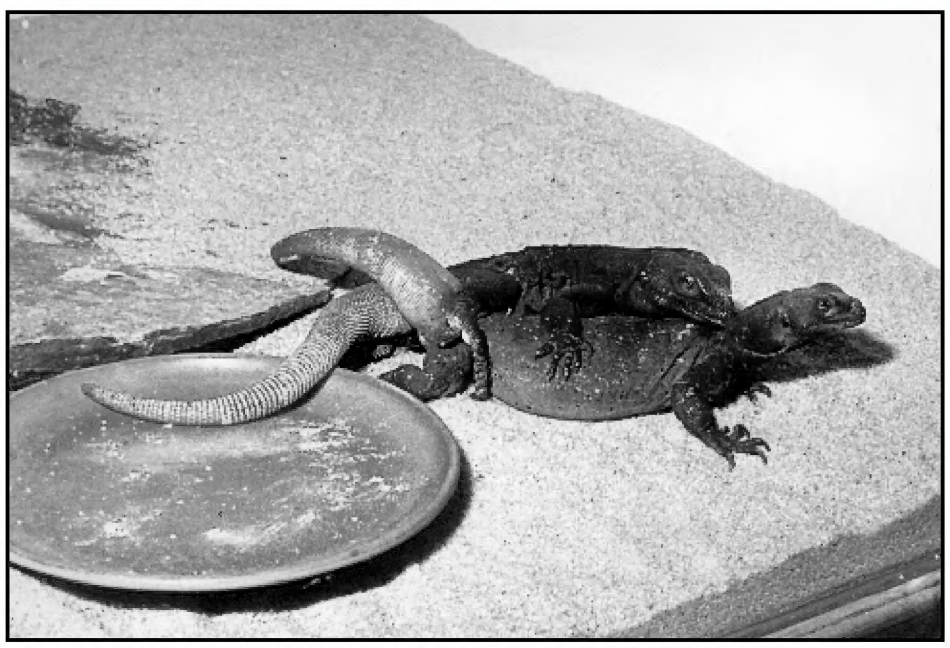

Figure 2. A pair of the author's Arizona chuckwallas mating in captivity.

in my captive chuckwallas was between 33 and 34 days, but Crooks (1983) observed a 50-day interval, possibly due to a different thermal regime and/or lack of a suitable nesting area. The nest box should be placed in the cage as soon as a change in behavior is observed. This will allow the female adequate time to find the nest box and dig the nest chamber. Delaying oviposition unduly can put the female at risk for dystocia (egg-binding) and possibly lower the viability of the eggs (Divers and Williams, 1993). Decline in reptile egg viability may occur when extraneous calcium is deposited on the eggshell, reducing porosity, and hence gas exchange (Wink et al., 1990).

I do not recommend moving the female to a different cage for nesting purposes. Two of my females became stressed when placed in unfamiliar surroundings, terminated digging activity, and expended energy trying to escape the cage. Re-arranging the structural environment of the cage in order to accommodate a nest box had a similar effect. Ideally, the cage environment should be planned in advance so that a nest box can be placed without disturbing existing rock shelters and basking sites. Despite these cautionary remarks, it is sometimes possible to transfer gravid females to another cage for oviposition. At the Riverbanks Zoological Park, Columbia, South Carolina, gravid chuckwallas were removed from the large display enclosure because of previous difficulty in finding and retrieving eggs. The females were placed in cattle tanks with rock shelters and damp sand, whereupon they dug nest holes and deposited eggs (Scott Pfaff, pers. com.).

The nest box should be filled and packed tightly with slightly dampened sand (add just enough water so that the sand grains stick together when pinched). I have successfully used two basic nest box designs (Figure 3). The top-entrance box requires a stairway of rocks or bricks which enables the female to gain entry, but since a female generally tends to dig downward at cage corners, she does not readily find the entrance. The bottom-entrance nest box is more easily used by a female, but she is likely to block her own exit during the process of digging. Therefore, one or two top exit/entrance holes must be available; these top holes should be kept closed until the female has plugged the main entrance. If the nest box is clear plastic, it should be covered with paper to provide dark, secluded conditions. Portions of the paper can be removed for viewing purposes, but care should be taken to avoid disturbing the female. The nesting female may require one and a half days to construct the nest tunnel and chamber. Periodically, she will leave the nest box to rest under the heat lamp, presumably restoring optimum body temperature.

I observed limited nest site defense behavior by the gravid female. On one occasion, a small, subadult female attempted to enter the nest tunnel and was driven away. Subsequently, the adult male approached the nest hole while the female was digging; she hissed and tail-slapped, and the male retreated. I observed another gravid female hiss at a male in an apparent attempt to drive him away from her digging site. My observations confirm the potential for defensive behavior during nest construction, but these interactions are not likely to occur often in nature. Furthermore, unlike the ecological setting of *Sauromalus varius* (Lawler, 1994), suitable nest sites are probably

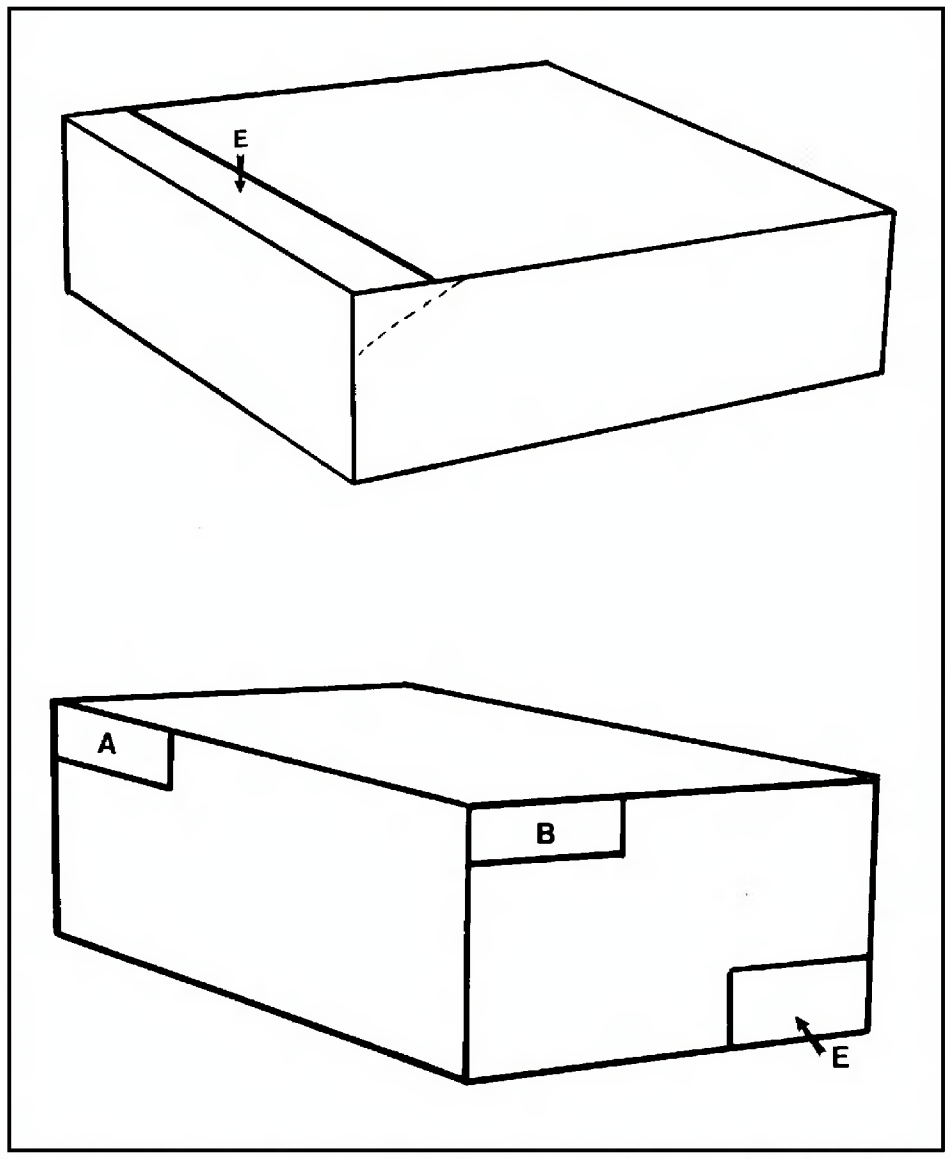

Figure 3. Upper: Top-entrance nest box used by gravid chuckwallas. The dimensions of the box are 57.5 cm (23 in) × 41.9 cm (16¾ in) × 15 cm (6 in). Entrance space (E) is about 8.1 cm (3¼ in) wide. Dashed line indicates slope of sand packed into box. Lower: Bottom-entrance nest box, with entrance (E) and top exits/entrances (A, B). Dimensions are 37.5 cm (15 in) × 27.5 cm (11 in) × 13.4 cm (5½ in). Openings are about 11.5 cm (4½ in) × 4.5 cm (1¾ in).

not limiting for *S. obesus*, and several individuals would not normally be in close association or competing for nest sites.

Nesting behavior in chuckwallas has not been previously reported. Schiberna (1995) induced oviposition by oxytocin injections, and the female chuckwalla kept by Crooks (1983) laid eggs in the food bowl. My observations reveal that nesting behavior is remarkably similar to that described by Blair (1994b) for the iguanid genus *Cyclura*. The female digs the nest tunnel with her front feet, followed by alternate kicking of sand with the hind feet. She enlarges the end of the tunnel enough to turn around, and then lays her eggs. Exposed eggs were found to be partially separated from each other by thin layers of sand, suggesting by inference that the female uses her hind feet to pack sand around each egg after it is laid. After all the eggs have been deposited and covered, the female leaves the tunnel and re-enters it head first, pushing sand with her front feet and firmly tamping it with her snout. When the entire tunnel is filled, she crawls over the entrance area in a circular fashion, dragging her abdomen and kicking sand with her hind feet. This behavior may resume periodically for a day or so. In one instance, after I had removed the nest box from the cage, the female was observed the following day crawling in circles and kicking sand into a large mound (30 cm in diameter) where the nest box previously sat.

Egg Incubation

After the eggs have been laid, the nest box is removed from the cage. The eggs are carefully exposed and then placed in a standard (32 cm × 17 cm × 9 cm) plastic shoe box containing damp vermiculite. I use a vermiculite-to-water ratio of 1:0.75 (240 g of vermiculite mixed with 180 g of distilled water) for a standard shoe box. I recommend a coarse grade of vermiculite such as "Schultz-Instant" Horticultural Vermiculite (Schultz Co., St. Louis, MO). Julie Layton (pers. com.) has successfully used perlite as an incubation medium for chuckwalla eggs. Fine granular or flaked vermiculite (such as Hyponex, Hyponex Corp., Marysville, OH) has a tendency to compact around the eggs, eliminating air spaces, and possibly leading to suffocation of the eggs (Douglas, 1993). Fine sand is similarly detrimental, preventing gaseous exchange between the eggs and atmosphere. I incubated seven eggs in fine sand at 30°C; four eggs spoiled early in incubation. Two eggs failed to hatch and when opened, dead young were found. Based on their state of development, I estimate one died approximately 20 days, and the other 10 days, before hatching. One egg hatched, but the neonate exhibited serious neurological abnormalities suggestive of oxygen deprivation. Douglas (op. cit.) attributed most reptile egg mortality to suffocation or handling. Eggs may survive artificial incubation in fine vermiculite because they are only partly buried, or simply placed in a depression on the surface.

The shoe box is covered with Saran Wrap before replacing the lid to prevent evaporative water loss along the lid's edges. Ventilation is provided by making four holes, 2 mm in diameter, in the walls at both ends of the shoe box. During incubation, tiny beads of condensed moisture will be observed on the container walls above, as well as trapped within, the vermiculite. The vermiculite immediately surrounding the eggs will dry rapidly as the eggs absorb moisture. Also, as moisture is lost through the ventilation holes, the upper layers of vermiculite will gradually dry. This is not detrimental as long as some moisture is present ca. 25 mm below the surface, but to avoid further water loss and to maintain a saturated atmosphere, a small plastic cup (ca. 55 × 25 mm), should be filled with water and placed inside the shoe box at each end near the air holes; the cups can be replenished with water as needed.

Healthy, calcified eggs are plump and chalky white when removed from the nest box. Fertility is indicated in eggs immediately after laying, by a pink embryo spot which can be seen readily under a fluorescent plant light. The eggs should be handled carefully, and the upward orientation of the embryo spot must remain unchanged when transferring the eggs to the shoe box. The eggs should be completely buried; if there are any indentations on the shell, these should disappear as the eggs become turgid over the next 12 hours.

Chuckwalla eggs are relatively large; measurements from seven recently laid eggs were 37 to 38 mm × 21 to 24 mm ($\bar{x}$ = 37.6 × 22.1 mm). An additional seven eggs produced at the Riverbanks Zoological Park, South Carolina, measured 29 to 37 mm × 21 to 25 mm ($\bar{x}$ = 33.4 × 22.3 mm) (Scott Pfaff, pers. com.). These dimensions compare favorably with data from Schiberna (1995). The size of 17 oviductal eggs mea-

sured by Prieto and Sorenson (1977) was 21 to 36 mm × 12 to 19 mm ($\bar{x}$ = 28 × 14 mm). These authors also found three clutches in the field during August, which ranged in size from 24 to 49 mm × 14 to 28 mm ($\bar{x}$ = 41 × 23 mm). Berry (1974) determined that potential clutch size varies from 6 to 13 ($\bar{x}$ = 7.8 eggs in 22 females). Abts (1988) obtained an average clutch of 6.9 eggs in 115 females, and found that clutch size is significantly correlated with female body size. At the Royal Rotterdam Zoological Garden, The Netherlands, a female chuckwalla (no. 701046) produced an apparent maximum clutch of 14 eggs (Gerard Visser, pers. com.); also, at the Riverbanks Zoological Park, South Carolina, female no. 107 produced a clutch of 14 eggs (Scott Pfaff, pers. com.).

Abts (1988) concluded that female chuckwallas in the Colorado Desert of California reach reproductive maturity at a size as small as 127 mm snout–vent, which based on recapture data was achieved in the second year of life by most females. In contrast, Berry (1974) estimated that Mojave Desert females became reproductively mature at five years of age; the smallest female with enlarged ovarian eggs was 145 mm snout–vent.

Nagy (1973) found that chuckwallas may suspend reproduction during drought years when food is scarce. Furthermore, Berry (1974) noted that not all adult females lay eggs every year; only 42 percent of 47 females collected during the breeding season had enlarged follicles. Johnson (1965) collected 19 adult females during the reproductive season of which 13 were apparently reproductively inactive. But, Prieto and Sorenson (1977) inferred an annual cycle in southern Arizona based on autopsied females, including two marked females that contained oviductal eggs and were known to have laid eggs the previous season. Wild-caught females brought into captivity may breed in alternate years initially, but they usually switch to an annual schedule, probably due to an increased and predictable food supply. One Arizona chuckwalla produced five eggs in 1993, none in 1994, seven in 1995 and six in 1996. A chuckwalla from California's Mojave Desert laid four eggs in 1992, zero in 1993, seven in 1994, five in 1995 and four in 1996. The nutritional status of the female may influence clutch size. For example, the California chuckwalla received relatively less food (based on measured daily rations) during the 1995 and 1996 seasons than in 1994.

Seven clutches of chuckwalla eggs produced at the Riverbanks Zoological Park, South Carolina, were laid on the following dates: 17 May 1992, 4 May 1993 (2), 17 May 1993, 28 April 1994, 23 May 1994 and 1 June 1996 (Scott Pfaff, pers. com.). My chuckwallas deposited eggs on 20 May 1994, 2 June 1995, 4 June 1995, 13 June 1996 and 21 June 1996; dates for two clutches were not recorded, but were in late May. The dates for oviposition in captivity are generally early compared with those from nature. Abts (1988) noted oviposition occurring just prior to the summer rainfall during the first three weeks of July at a Colorado Desert study site in California. Johnson (1965) noted egg laying by a female on 22 June in the western Mojave Desert. According to Prieto and Sorenson (1977) oviposition occurred from July through August in southern Arizona.

Information is very limited for incubation temperatures of chuckwalla eggs in nature. Johnson (1965) discovered a nesting chuckwalla at his study site in the Mojave Desert. He inserted a temperature probe at the nest site and with a distance temperature recorder monitored temperature fluctuations over a four-day period. The nest site experienced a temperature range between 32.2 and 36.1°C.

Under artificial conditions, the incubation period appears to vary according to temperature (Figure 4), but differences in accuracy among incubators make comparisons somewhat difficult. Schiberna (1995) incubated eggs between 28 and 30°C, and hatching began after 93 days. Reliable incubation data were available for five clutches from chuckwallas at the Royal Rotterdam Zoological Garden (Gerard Visser, pers. com.). Part of one clutch held at 28°C hatched between 89 and 95 days, while the remainder kept at 30°C hatched in 82 days. Four clutches incubated at 32°C hatched as follows: one in 74 days; one in 76 days; one in 78 days; one with three eggs in 76, 77 and 95 days. James Edwards (pers. com.) incubated one egg at 30°C and it hatched after 97 days. Incubation data were obtained for 12 eggs produced at the Riverbanks Zoological Park, South Carolina (Scott Pfaff, pers. com.). The mean incubation temperature was 29.1°C; one egg hatched after 107 days, two eggs after 109 days, four eggs after 110 days, four eggs after 111 days, and one after 112 days. The long incubation periods for eggs in this clutch suggest significant daily temperature oscillations. I incubated one clutch at 30°C and one egg successfully hatched after 95 days. Two additional clutches of four and six eggs were incubated at 32°C. In the clutch of six, two eggs hatched in 88 days, one egg each hatched in 89 and 90 days, and two eggs hatched after 92 days. In the clutch of four eggs, two hatched after 91 days, and one egg each hatched at 92 and 93 days. Crooks (1983) incubated eggs at 32°C and hatching occurred after 67 days; this remarkably short incubation leads me to suspect that the temperature may have been higher than 32°C. Prieto and Sorenson (1977) incubated five eggs which hatched in 74 days at 35°C.

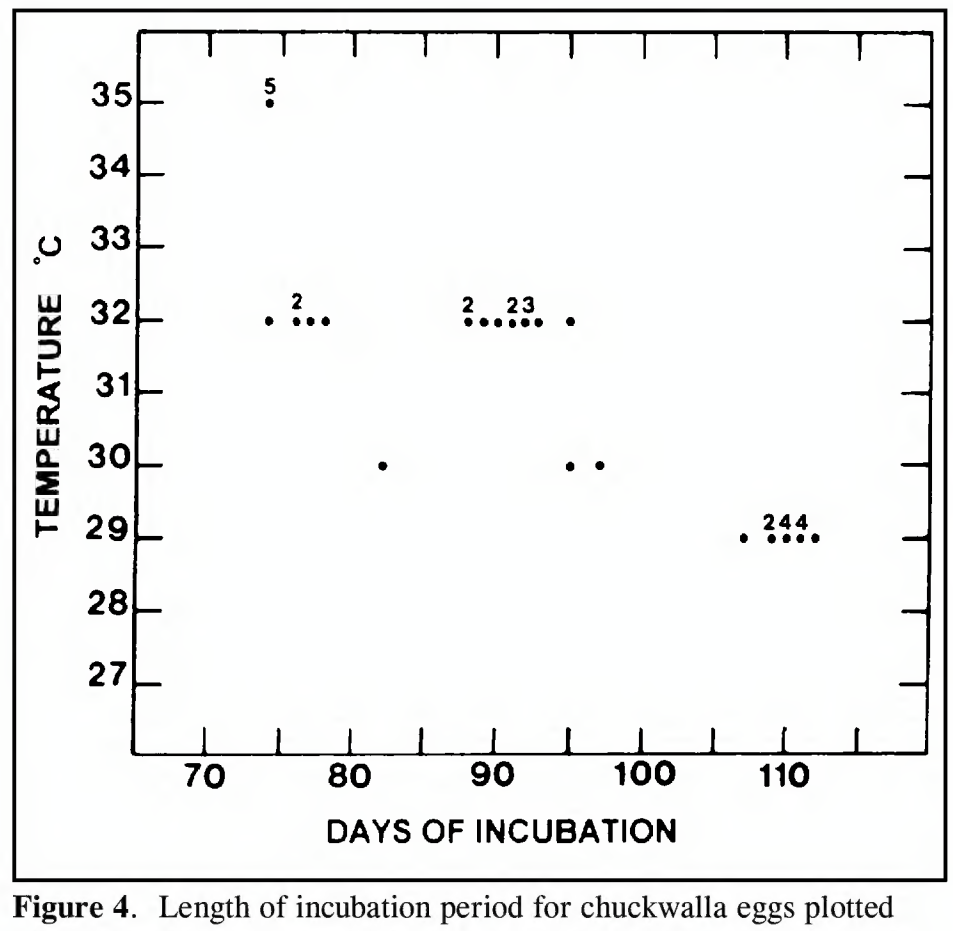

Figure 4. Length of incubation period for chuckwalla eggs plotted against incubator temperature. Numbers above dots indicate sample sizes greater than one.

Gerard Visser has suggested (pers. com.) that incubation temperature may influence the sex ratio in chuckwallas. Visser believes that a 50:50 sex ratio may be obtained near 30–31°C, with higher temperatures yielding a preponderance of males and lower temperatures producing females. Young can be sexed at about 82 days of age, provided they have made good growth (94 to 103 mm snout–vent). In a clutch of six eggs from my Arizona chuckwalla held at 32°C, two hatchlings are male and four are female. But, four eggs from my California chuckwalla held at the same temperature produced all males. However, most incubators do not maintain a steady temperature and there can be slight variations at different levels in the incubator box. Further studies with precisely controlled temperatures will be needed to evaluate this question. The results presented here do not appear to fit a temperature-dependent sex determination (TSD) pattern; see Viets et al. (1994:49) for further discussion of TSD in iguanid lizards.

Care of Hatchlings

Once the eggs have been pipped, the hatchlings remain in the egg with their heads protruding (Figure 5) for 15 hours (Crooks, 1983) up to about 24 hours (Schiberna, 1995). Most of my hatchlings emerged within these time limits. Berry (1974) found hatchlings in the field as small as 46 mm snout–vent. Crook's (op. cit.) hatchling was 53 mm snout–vent. Prieto and Sorenson (1977) reported hatchlings from 53.9 to 79.6 mm snout–vent ($\bar{x}$ = 64.6 mm), but evidently some of these young had already grown considerably when measured. My seven Arizona hatchlings (including one from a previous clutch) ranged from 59 to 65 mm snout–vent ($\bar{x}$ = 61.3 mm); four California hatchlings were 58 to 60 mm snout–vent ($\bar{x}$ = 59 mm). Twelve hatchlings at the Riverbanks Zoological Park, South Carolina, varied between 50 and 58 mm snout–vent ($\bar{x}$ = 53.7 mm), and weighed between 6.0 and 9.6 g ($\bar{x}$ = 8.4 g); an additional five hatchlings from the zoo weighed between 4.9 and 7.2 g ($\bar{x}$ = 6.4 g). The hatchlings from the Riverbanks Zoological Park were smaller than my hatchlings, possibly because they were incubated in a drier medium (3:1 vermiculite-to-water ratio); moisture levels in the incubation medium can influence hatchling size in lizards and other reptiles (Packard and Phillips, 1994; Overall, 1994; Phillips et al., 1990).

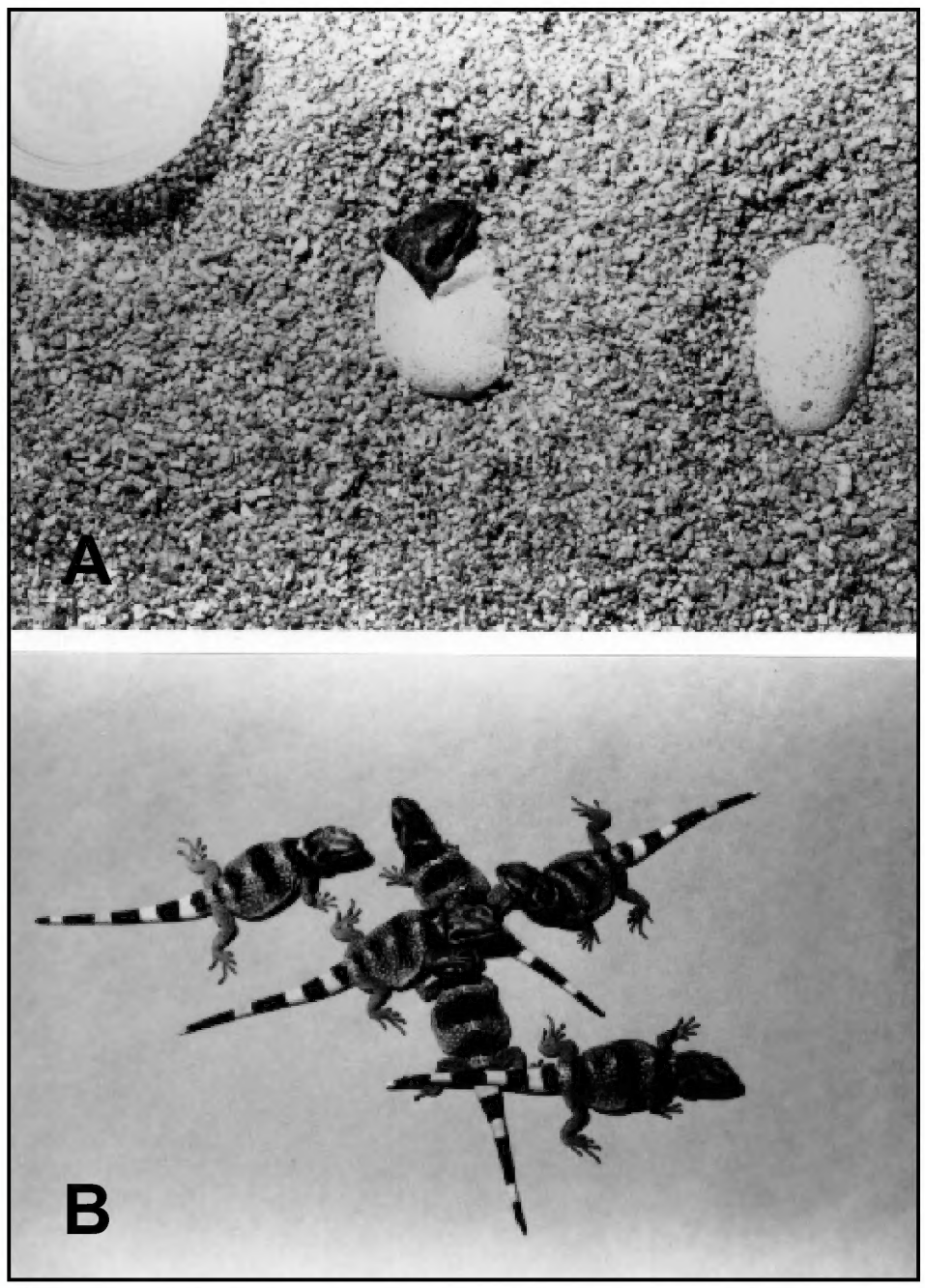

Figure 5. A) Hatchling chuckwalla with head protruding from the egg, and another egg exposed in coarse vermiculite. Also note small water dish (upper left) for maintaining humid atmosphere. B) Six hatchling chuckwallas less than one week old.

Neonates can be housed in a "40 breeder" tank (ca. 91.5 × 45.8 × 43.3 cm) for rearing during the first year. To avoid crowding, only three to four individuals should be housed in the same tank. A floodlight (either 150 w or 75 w depending on distance from basking site) should be mounted near one end of the tank. I use newspaper covered with paper towels as the substrate until the lizards are six to nine months old. Numerous flat rocks provide shelters and basking sites.

The hatchlings are fed two to three times daily for the first month or so; hatchling and juvenile iguanids are capable of processing more food per unit time, relative to body mass, than adults (Troyer, 1984). Leafy greens are finely chopped; frozen green beans and frozen chopped collards are processed (while frozen) through an electric food processor ("Salad Shooter"). The small bits of food are rinsed in a screen basket, pressed between paper towels, and then separated with a fork. At each feeding, vitamin/mineral powder is sprinkled lightly over the food. The occasional addition of finely chopped hard-boiled egg or pulverized "monkey biscuits" to the salad will enhance protein content and increase growth rate. In other iguanid species, it is important to offer food to groups of juveniles on several plates evenly distributed within the cage to ensure that dominant individuals do not exclude subordinates from feeding (Alberts, 1994). Differences in social hierarchy do not appear to affect access to food among juvenile chuckwallas, but in any case, my lizards are fed ad libitum. I do not recommend placing the young into hibernation until after their second season of growth to reduce the risk of mortality from dehydration, a potential problem for first-season hatchlings. Alternatively, the juveniles may be hibernated for only about a month or two.

A prevailing idea among breeders of iguanid lizards is that the neonates must be inoculated with the intestinal microflora of the adults via coprophagy in order to digest plant material successfully. Troyer (1982) observed hatchling green iguanas in nature ingesting the feces of older iguanas, and concluded that this was the mechanism by which fermentative colonic microbes were acquired. However, the two most prevalent bacteria in the hindgut of iguanas (*Clostridium* and *Leuconostoc*) are found abundantly in nature, and coprophagy need not be invoked (McBee and McBee, 1982).

With regard to chuckwallas, Nagy (1973) reported finding a small amount of feces (from rodents; see Nagy, 1977) during

stomach contents analysis, suggesting that coprophagy can occur in nature. The intestinal microflora of chuckwallas has not been studied, but in any case, it seems plausible that hatchlings obtain their fermentative bacteria simply by tongue-flicking the substrate or the feces of older chuckwallas. I observed attempted coprophagy in 10 of my hatchlings (including one lizard less than six hours old), but the feces of adult lizards were generally too large for the hatchlings to ingest successfully. Nonetheless, the hatchlings seized dried fecal droppings in their mouths, attempted to chew them, and then shook them violently. One hatchling succeeded in breaking off a small piece of a dried fecal pellet and ingested it. On 11 occasions hatchlings were offered dried feces of adults; the young always tongue-flicked the feces and then attempted to eat them. However, the lizards ignored their own feces, or showed only brief interest in them after adult feces had been removed. Whether the digestive efficiency of hatchlings is affected by their exposure to the droppings of adults needs to be investigated.

Agonistic and Other Behaviors

Adult male chuckwallas are aggressively territorial (Berry, 1974), and should not be kept together. If several males are caged together, a dominance hierarchy based on body size will likely be established through aggressive interactions, and occasional agonistic encounters may follow. Two adult males of nearly equal size will usually fight intermittently, eventually leading to serious injury. I am familiar with one case in which two large males fought until one lizard sustained a broken humerus when bitten by the other. Even in spacious enclosures, large males may continually chase smaller males, causing them stress. Agonistic behavior is prevalent in the spring, but may subside at other times. Nagy (1973) observed that territoriality and other costly social behaviors in nature are suspended during drought years. I observed agonistic behaviors, including vigorous head-bobbing, tilting, face-off and biting attacks (cf. Berry, 1974) between male chuckwallas as early as five months of age (ca. 98 to 103 mm SVL); such behaviors were temporarily suspended during feeding.

Caging males together may also lead to pseudocopulation, a possible form of social dominance sometimes observed in iguanid lizards (Frye and Townsend, 1993:62). Prieto and Sorenson (1977) noted seven cases of homosexual mountings between dominant and subordinate male chuckwallas in the laboratory. I observed a large (200 mm snout–vent) dominant male forcibly mount a smaller, nondisplaying male (135 mm snout–vent, but with adult coloration), causing superficial lacerations about the neck area. In the cases reported by Prieto and Sorenson (op. cit.) the subordinate males were nondisplaying individuals.

Schiberna (1995) kept females and two males together, apparently compatibly, but an unreported dominant/subordinant relationship may have been initially established. I temporarily kept a small, melanistic, yellow-tail male with a large melanistic orange-tail male. Surprisingly, I observed unidirectional aggression from the yellow-tail male directed toward the orange-tail male. The latter did not exhibit any aggression toward the former, possibly because melanistic females with pale-colored tails are present in the orange-tail chuckwalla population. In the yellow-tail population, only males are melanistic whereas females are either pale brown or whitish gray.

Berry (1974) noted agonistic encounters between females in which large females chased small females from preferred basking sites. I observed such interactions between captive females on four occasions, but in three cases, it was a small female that chased a large female from a basking spot. These events occurred after feeding.

Berry (1974) noted several possible means by which chuckwallas may communicate through chemical signals. These include: rubbing the jaws on the substratum, rubbing femoral pore secretions on the substratum, defecation, urination, cloacal wiping and the hip sway. Berry (op. cit.:50) stated that jaw-rubbing the substrate is a frequent behavior, occurring during courtship, aggression, or when solitary. Berry suggested that scent-producing glands may be associated with the jaws or eyes of the chuckwalla. Berry (op. cit.:41) recognized another type of jaw-rubbing based on context, termed "mate jaw-rub," which occurs between a male and female (both sexes engage in it). Instead of rubbing the substrate, an individual rubs various sites on its mate, including the abdomen, legs, groin, dorsum, head, neck and throat.

Other lizard species have been observed to rub their jaws on the substrate, including *Iguana iguana* (Burghardt et al., 1977), *Sceloporus occidentalis* (Duvall, 1980) and *Sceloporus jarrovi* (Simon et al., 1981). Duvall (op. cit.) suggested that the Harderian glands near the eyes may deposit secretions during jaw-rubbing behavior. Simon et al. (op. cit.) were unable to find histological evidence of integumentary glands in the infralabial area of *S. jarrovi*.

I have observed scores of jaw-rubbing episodes during my study of chuckwallas and the behavior closely agrees with the illustrations in Berry (op. cit., Figure 16 b-d). When the behavior was observed at close range (ca. 30 cm), I noticed that the chuckwalla's eyes were bulging, and that grit or other debris adhering to the anterior corner of the eye was being wiped onto the substrate. I observed eight chuckwallas closely over a period of 14 weeks, and a total of 34 jaw-rubbing episodes were recorded. In 27 cases (79.4%) grit or other debris was seen in the corner of one, or both eyes; subsequently the material was dislodged during jaw-rubbing behavior. In these cases, eye-bulging coincided with jaw-rubbing, but on nine occasions, eye-bulging preceded it. Eye-bulging in lizards is caused by elevating blood pressure within the sinus orbitalis, forcing sand and other debris out from the anterior corner of the eye; the mechanism is described in detail by Heath (1966). In one case of jaw-rubbing, shed skin was adhering to the eyelid and upper jaw of the chuckwalla, and the rubbing behavior aided in its removal. In another case, numerous mites were attached to the eyelids, and the eye-bulging and subsequent jaw-rubbing are interpreted as attempting to remove the ectoparasites. In five cases (14.7%), no debris was noted in the corners of the eyes, and there was little or no eye-bulging, so the purpose of the jaw-rubbing could not be established with certainty. But significantly, there was no evidence of fluid secretions from the corners of the eyes in these, as well as the

other cases. Eye-bulging in association with jaw-rubbing behavior was not mentioned by Berry (op. cit.), but under field conditions, she may not have been able to observe it.

Berry (op. cit.) did not attribute a specific function to "mate jaw-rub" behavior, but it is apparently not a scent deposition mechanism. Such a function makes little sense in the context of individuals that are in visual and physical contact with one another. "Mate jaw-rub" behavior is probably tactile communication that promotes familiarity between courting individuals, ultimately facilitating pair bond formation and copulation.

Whether "substrate jaw-rubbing" is a mechanism for transmitting a chemical signal is now less certain, based on my observations of captive chuckwallas. The behavior is more probably a means to clean the eyes rather than to deposit a chemical signal from either the eyes or jaws. In the majority of the cases, grit, adhering shed skin, or mites were removed from the eye corners or periorbital areas. Furthermore, I suggest that some episodes of "mate jaw-rub" may also serve this purpose. In two instances, I observed chuckwallas removing grit from their eyes by rubbing against their mates, rather than against a rock.

Berry (1974:41) mentioned 20 distinct behaviors associated with courtship. I observed several of these (tunneling, nudging and jaw-rubbing) by a juvenile female chuckwalla (90 mm snout–vent) making prolonged physical contact with an adult female placed in the cage with her for the first time. The behaviors of prereproductive females are usually directed toward adult males (Berry, op. cit.).

Schiberna (1995) reported a peculiar behavior in hatchling chuckwallas. The lizards were observed to "roll around" in a dish of moist, grated carrots. I also observed this behavior in my hatchlings when grated carrots, finely chopped lettuce, or green beans were placed in the cage. The hatchlings pushed forward through the salad, leaning to one side or the other, rolling their hips, and lashing their tails in a lateral or circular motion. Schiberna interpreted this behavior as a means of absorbing moisture, but according to Zug (1993:239) reptiles cannot absorb water through their skin. Furthermore, some aspects of my observations are not consistent with the hypothesis of cutaneous absorption. The hatchlings did not linger in the salad, but rapidly thrashed about and then left. One hatchling exhibited the behavior on a flat rock surface covered with fecal droppings, a basking site used by adults. Also, the behavior essentially ceased about six days after hatching. A plausible alternative explanation is that the hatchlings are removing shedding scales and flakes of dried albumin and other debris that were adhering to their skin shortly after hatching.

When a chuckwalla, sequestered in its shelter, is suddenly exposed, it may occasionally exhibit an unusual threat behavior in which the mouth is held open, an audible hiss may or may not be emitted, and the vertebral column undulates in a sinuous, serpentine manner. This behavior was usually noted when chuckwallas were removed from their shelters in the evening; at this time the lizards were resting and relatively cool.

Hygiene and Disease Treatment

The cages are routinely cleaned during the evening hours when the lizards are hidden in their shelters, and thus they are not stressed or alarmed by my activities. The glass front of the cage requires frequent cleaning because salt droplets, sprayed from the chuckwallas' nostrils, rapidly accumulate on the glass. Feces are removed every 24 to 48 hours, depending on the number of lizards kept in a cage. A fine sand substrate is superior for absorbing moisture associated with the droppings. The feces can be collected with a scoop constructed of 3 mm mesh screen that allows the sand to fall through. Annually, the sand is removed from each cage, washed thoroughly and heat-sterilized, or discarded and replaced with clean sand.

Mites, *Hirstiella pyriformis* and *H. trombidiiformis* (Mader et al., 1986; Werman, 1980), are serious and pervasive ectoparasites of chuckwallas. In captivity, chuckwallas frequently displayed behaviors suggestive of minor irritation (pruritus) by the ectoparasites. The most commonly observed behavior was using the hind legs to scratch the head and neck areas, where mites appeared to be most concentrated. On two occasions, I observed a chuckwalla removing mites from its cage-mate. On 18 July 1993, a male chuckwalla was observed lying partly on top of a female. The female's lower back was situated directly in front of the male's head. At a distance, the male appeared to be "pecking" the female's back. I approached the cage within 15 cm of the glass front and noticed the male "dabbing" with his tongue, the small, red, immature stages of the mite which were crawling on the female's back. He proceeded to also remove mites from the base of the female's tail. During this activity, the male's eyes were directed forward and he moved his head in short, erratic lateral jerks, as he followed the crawling mites. On 17 April 1994, the female was resting on top of the male when I observed her dab the male's lower back several times with her tongue; she appeared to be removing mites from the male's back (rather than simply tongue-flicking); she then moved away, paused and used her left hind foot to scratch the left side of her head and neck.

As far as I am aware, mite removal behavior in chuckwallas has not been previously reported, and the prevalence of this behavior under natural conditions is unknown. Mite removal behavior would likely be elicited by high densities of mites, tactile irritation, and close association among lizards; such circumstances presumably would arise less frequently in nature than in captivity. However, wild-caught chuckwallas with heavy mite loads have been reported (Hunter, 1966; Werman, 1980), and in nature, individual chuckwallas are frequently in close proximity, as for example, when immatures bask together, or when (as reported by Berry, 1974) prereproductive females seek physical contact with mature males.

None of my captive chuckwallas was observed removing mites from its own body, although on one occasion, a male extended his left hind leg and then turned his head as if to examine the leg, but he did not "dab" any mites. Apparently portions of the hind legs, lower flanks and tail of a lizard can be reached by the tongue, as confirmed by Bruce Elfstrom (pers. com.) who observed a captive *Ctenosaura quinquecarinata* removing mites from its own body. Although tongue-

dabbing appears to be a specialized behavior for dealing with these ectoparasites, I have observed chuckwallas and other iguanids using the tongue in a similar manner to procure small food items from the ground (e.g., fallen flower petals, small leaves, etc.).

All newly acquired chuckwallas must be quarantined and thoroughly inspected for mites. I have recently described a procedure by which mites are substantially reduced on the lizard using a nontoxic rinse. Then by continual removal of gravid mites and their egg cases at ovipositional sites, the infestation is eradicated (Montanucci, 1997). The procedure is best accomplished in a quarantine cage and may require four weeks or more to complete.

Soft ticks (*Ornithodoros*) sometimes infest chuckwallas. These large ectoparasites should be dabbed with alcohol using a cotton swab, and then removed with small tweezers. As a precautionary, the site of attachment can be treated with a disinfectant. My limited experience with soft ticks is that soon after the chuckwalla is placed in captivity, they quickly drop from the host and die.

Chuckwallas harbor nematodes in their large intestines, but they have not been found elsewhere in the digestive tract (Nagy, 1977). There has been speculation about the possible role of nematodes in the digestive efficiency of herbivorous iguanids and controversy concerning the use of anthelmintics. Iverson (1982) suggested that nematodes in herbivorous lizards may have a commensalistic or even mutualistic role, possibly aiding in the mixing and chemical breakdown of vegetation, producing useable waste products (vitamins, cellulase), or regulating abundance and composition of colonic microbes. However, Wright (1992) argued that nematodes are generally pathogenic, and because captivity can be stressful to the host, advocated the use of anthelmintics. Furthermore, he alluded to a report by Hansen and Sylber (1979) in Iverson (1982:73) that there was no evidence that deworming chuckwallas (*Sauromalus varius*) had any effect on their digestive efficiency, but Iverson (op. cit.) questioned whether deworming had actually been successful.

The role of nematodes in chuckwallas and other herbivorous iguanids needs further research. But, I suggest that lizards obtained from a pet store or commercial dealer should be routinely treated with anthelmintics because of the high risk of fecal contamination from a variety of exotic reptiles. No intervention is necessary for chuckwallas procured directly from the field, unless the lizard shows unexplained weight loss or abnormal stools. Crooks (1983) treated his lizards with a single dose of Fenbendazole (Panacur, Hoechst Pharmaceuticals) at a dose rate of 200 mg/kg. Regis Opferman (pers. com.) suggests Panacur at a dose rate of 50 mg/kg in four treatments 10 to 14 days apart.

Chuckwallas are sometimes afflicted by abscesses (inflammatory lesions), particularly on the digits and limbs. I have seen six cases (all adult males): 1) an abscess on the tip of the snout, left palmar surface, right front second and fourth digits; 2) lesions on the left front first and fifth digits; 3) an abscess on the left front fifth digit; 4) a large abscess encompassing the left hind foot and shank as well as an abscess on the left front third digit; 5) an abscess on the right front fifth digit; 6) an abscess on the mandibular symphysis. In nature, abscesses seem to occur predominantly in males, and I suspect that injuries resulting from agonistic encounters are the probable cause. Although punctures from cactus spines may cause some lesions, I did not find cactus spines in any of the lesions examined. In captivity, inflammatory lesions may arise when one lizard bites another, and the bitten area becomes infected. Bacteria of the genus *Serratia* have been cultured from the caseous exudate of abscesses in *Sauromalus varius* (Lawler and Jarchow, 1986). Recommended treatment involves incision, drainage, antiseptic and antibiotic medications (Frye and Townsend, 1993:78) , but if a digit is involved, amputation is a simple remedy (F. L. Frye, pers. com.). I successfully treated the infected digit of one lizard by careful incision and removal of the caseous exudate, followed by application of the disinfectant Nolvasan (chlorhexidine gluconate). Abscesses require prompt attention, otherwise the infection can spread from a digit to the entire limb (see Frye, 1973, Figure 79 a & b). In captivity, the risk of having a toe bitten is greatest when chuckwallas sit in the food dish while the group is feeding. Generally, however, these lizards appear to carefully pick food items from between the toes of their cage-mates, and bites are rare events; only four instances were noted during my study.

Stomatitis has been recorded in *Sauromalus varius* (Lawler and Jarchow, 1986); the bacteria *Neisseria* and *Pseudomonas* were isolated in these cases. I have observed stomatitis in *S. hispidus*, but have not observed any cases in *S. obesus*. I noted an eye infection (excessive drainage and failure to open) in an old female *S. obesus*. Each eye was treated with one drop daily of AK-spore ophthalmic solution (Neomycin and Polymixin B. Sulfates); the infection cleared in five days.

Bacterial diseases seldom afflict chuckwallas if they are maintained in a proper thermal and hygienic environment. The production of antibodies, which is crucial to disease resistance, is enhanced by elevated body temperature. *Sauromalus obesus* experimentally held at 35°C produced high titers of antibodies against *Salmonella* antigens, but at 25°C, antibodies were low or absent after three weeks (Evans, 1963). Muchlinski et al. (1989) studied a fever response in chuckwallas experimentally injected with the bacterium *Aeromonas sobria*. Bacteria-injected lizards had a mean preferred body temperature of 39.1°C whereas saline-injected animals had a mean of 36.8°C. Knowledge of bacterial pathogenicity in chuckwallas is limited; Caldwell and Ryerson (1940) determined that *Pseudomonas reptilivorus* is pathogenic in these lizards.

Ecdysis occurs periodically during the active season and generally presents no problems if the lizards are feeding on a nutritionally balanced diet, and are not infested with mites. Chuckwallas typically shed their skin in large patches on the body and limbs at different times. The digits and tail tip should be examined carefully for any adhering skin that may cause constrictions. Also, the nasal scales (surrounding the external nares or nostrils) sometimes fail to shed. I have used fine forceps to remove small pieces of epidermis and a modified

straight pin with a curved, blunt end, to lift individual scales. The epidermis on the tail is never shed all at once. Usually the basal area is removed with patches from the body, and the remainder may be shed in fractions at different times. The process may take weeks, so do not be too impatient about removing old skin that will eventually come off by itself.

Acclimation

Suggestions for acclimation apply primarily to wild-caught lizards; captive-bred animals are far less problematic and are highly recommended. Chuckwallas purchased as captive-raised adults are also hardy, but are subject to stress when moved to a new cage and/or when there is a dietary change. Therefore, ascertain from the previous owner details about the cage environment and the diet and try to duplicate the conditions.

A newly acquired chuckwalla should be quarantined until mites have been removed and the general health of the lizard is confirmed. Under quarantine, the lizard should have adequate shelter and the proper thermal regime to reduce stress and facilitate adjustment. A cage with opaque walls and a glass front is desirable because it provides some visual barriers and thus creates secure, less exposed surroundings for the lizard.

Chuckwallas collected as adults and brought into captivity may suffer from what is termed a "general maladaptation syndrome," characterized in most reptiles by restlessness and refusal to eat, leading to inanition, dehydration and eventual death (Cowan, 1968). In chuckwallas specifically, the typical early manifestations of this syndrome (which I observed in five cases) are poor feeding (or outright refusal to feed) and constant climbing at one of the cage corners while "standing on the tail." The tail may develop kinks due to displaced vertebrae, and remarkably the body rapidly develops mild to severe kyphosis due to inward pressure exerted upon the vertebral column. There is progressive deterioration of the immune system from malnutrition and other stressors, eventually leading to death.

Wild-caught, gravid chuckwallas are also problematic, being at high risk for egg-binding due to stress from capture, transport, caging and dietary change; they should not be collected.

Hatchling and juvenile chuckwallas (compared with adults) have a much higher probability of adjusting to captivity, especially if maintained in small groups. Two juveniles that I kept singly lost appetite, but when subsequently placed with other chuckwallas, they showed marked improvement in all aspects of their behavior. New individuals placed with a group of long-term captives appear to benefit through social facilitation. The new lizard may be stimulated to eat by seeing other lizards feeding. If the new lizard is wary and nervous, it may become less so when surrounded by relatively calm cage-mates.

Wild-caught chuckwallas do not gain much weight during their first year in captivity; generally their dietary intake is near "maintenance level." By the second season, an "acclimated" chuckwalla will have an adequate appetite and show significant weight gain. The initial feeding in captivity can be stimulated by offering yellow dandelion flowers; subsequently various greens can be mixed with the flowers.

Collecting and Conservation

In Arizona and California, chuckwalla collecting is regulated by state laws that stipulate bag and possession limits, and commercial collecting is prohibited. In Nevada, chuckwallas can be collected commercially, but collecting by individuals requires a permit. In Utah, chuckwallas are protected and may be collected by permit only for scientific or educational use. The status of chuckwalla populations under current levels of regulated, noncommercial harvest is not known. However, in areas I have visited, the populations appear to be stable; even near major metropolitan centers such as Phoenix, chuckwallas are conspicuous and relatively abundant.

Experienced hobbyists who collect chuckwallas usually provide proper care for their animals, and thus meet most ethical concerns. However, from an ecological perspective, once a chuckwalla is removed from the breeding population, it is irrelevant whether the lizard is alive, enjoying dandelions in a terrarium, or dead. In addition to the removal of individuals, there are several issues pertaining to noncommercial harvest of chuckwallas that have significant ecological implications, such as methods of capture and release of captives.

In California, chuckwallas may be captured only by noose or by hand, and specifically it is unlawful to use any method that involves breaking apart rocks or granitic flakes. Obviously these destructive collecting methods can have enormous and long-term ecological consequences. Amateur groups in Arizona have insisted on the right to use pry bars and have opposed any attempted restrictions on collecting techniques. Concerning this issue, the Arizona state Attorney General ruled that the State Game and Fish Department did not have the legal authority to prohibit collecting methods that cause the disturbance of rocks. Despite this ruling, the Game and Fish Department will continue to seek some kind of restrictive legislation (Jeffrey Howland, pers. com.).

It is not uncommon to find degraded habitat at localities frequently visited by collectors who use pry bars, and these individuals, cognizant of the potential ecological consequences of their activities, must have a callous disregard for the environment. The destruction of rock crevices not only affects chuckwallas, but eliminates microenvironments for many other small vertebrate and invertebrate species. Furthermore, use of a pry bar is not only destructive, but inefficient, and puts the quarry at risk. According to collectors who have used the method, the lizard's instincts are to descend further into the enlarged crevice and wedge itself even more tightly; hence only slight release of pressure on the pry bar can cause the rock to crush the lizard. Other collecting methods, such as noosing or use of a dowel, are safe, effective and nondestructive. The latter procedure involves shading a rock crevice with a cloth and gently tapping the chuckwalla with the dowel until it moves toward the cloth to a position where it can be seized by hand. Ninety percent of 3,000 captures and recaptures by Abts (1988) were accomplished in this manner.

The release of long-term captive chuckwallas back into the

wild should be prohibited by state laws and discouraged among hobbyists. In many cases, the captives come from collections containing a variety of domestic and exotic reptile species, and the risk of these chuckwallas harboring microbial pathogens and endoparasites is great. Berry's (1974) intensive field study of chuckwallas revealed a strong social component to their behavior which, I believe, predisposes them to contracting diseases from released captives. An example of such a disaster come true involves the spread of upper respiratory tract disease (URTD) among populations of the desert tortoise, *Gopherus agassizi*. One epidemic resulted in the deaths of 627 tortoises and an infection rate of 43 percent on the Desert Tortoise Natural Area in Kern County, California (Jacobson et al., 1991). Strong circumstantial evidence indicates that URTD was introduced to the wild population by the release of sick captives. California law now prohibits the release of any captive amphibian or reptile.

Another possible consequence of releasing captives is genetic contamination of wild populations. In the vicinity of Phoenix, several chuckwalla populations of different color pattern classes inhabit adjacent, but isolated, mountain ranges (Hollingsworth, 1995). These differing populations presumably have had separate evolutionary histories for a considerable period of time and probably represent unique gene pools. In at least one case, a chuckwalla of a particular pattern class was observed in a locality where it does not naturally occur, and this can only be explained by human transport and release. Indiscriminate releases, if frequent and involving substantial numbers of lizards, could threaten the genetic uniqueness of some populations. Although the release of captives should be generally discouraged, some kinds of educational and research activities require collecting and keeping animals on a short-term basis, and in these cases, it is imperative that each, apparently healthy, individual is released at the site of capture.

A related issue concerns the genetic aspects of captive-breeding programs for the common chuckwalla. Nearly all lizards purchased from dealers and retail pet stores lack locality information. Consequently, chuckwallas bred in zoos and in the private sector often involve hybridizing different genetic stocks, resulting in the loss of characteristics unique to the various isolated populations. Although outbred progeny are often vigorous, breeding lizards from the same, known localities should be encouraged so that the unique qualities of the different chuckwalla pattern classes are not spoiled.

Lamb et al. (1992) examined mitochondrial DNA variation among desert iguana and chuckwalla populations and found geographic localization of mtDNA genotypes. In the latter species, 23 of the 30 site variant clones (77%) were represented by single locales. Among the seven remaining genotypes, six were restricted to two localities; three clones were found on both sides of the Colorado River. The authors could not draw conclusions about intra- or interpopulation variability because of small sample sizes, but there was no evidence that the Pliocene Bouse embayment of the Colorado River produced any genetic discontinuity between populations. The authors noted several factors conducive to mtDNA differentiation in chuckwallas: namely the discontinuous and patchy nature of suitable habitat, high adult survivorship, low annual reproductive frequency, and limited dispersal confined mostly to males (cf. Abts, 1987). Case (1976a) noted regional differences in body size in chuckwallas and attributed these patterns to climatic differences affecting plant productivity. Tracy (1995, 1996) explored the genetic basis of body size variation and noted differences in growth rates between large- and small-sized chuckwallas. The latter grew faster before, and slower after, sexual maturity than did those from populations that naturally have large adults.

The propensity for different chuckwalla species to hybridize is exemplified by the situation on Isla Alcatraz off the Sonoran coast, where a hybrid population involving *S. obesus*, *S. hispidus* and *S. varius* was produced through human transport and release (Robinson, 1972). Hybridization becomes a concern when it potentially threatens the gene pools of natural populations or the captive-breeding programs of endangered species. In recent years, hybridization has posed a potential problem for the captive-breeding program of the endangered species *Sauromalus varius* at the Arizona–Sonora Desert Museum, Tucson. A male *S. hispidus* escaped its enclosure and entered a colony of *S. varius* whereupon he bred at will with the females. Unfortunately, the eggs of these females were not destroyed, and subsequently some of the space and resources of the program had to be diverted to the hybrid progeny. Identification of hybrids between these two species is not easy, and in any case, would require confirmation by expensive DNA testing. The disposition of the hybrids now becomes problematic, and there are legitimate concerns that they could enter the Mexican government's breeding program or be released into the private sector to threaten the genetic integrity of a few pure *S. varius* held illegally by breeders. Additionally, it has come to my attention that some chuckwallas being sold as *S. hispidus* to private hobbyists bear white markings, a feature that does not typify the species, and may indicate that hybrids are already entering the market.

Commercial collectors annually supply *Sauromalus obesus* for the pet trade, and most of the lizards are assumed to come from Nevada where commercial harvest is legal. Several thousand chuckwallas have been collected in Nevada over the past three years (D. B. Hardenbrook, pers. com.), but which populations are being impacted and whether this harvest is sustainable are presently unknown. In Nevada, use of a pry bar is specifically prohibited, but there are no bag limits or harvest seasons for chuckwallas and other species of herpetofauna, and thus commercial collecting is an unregulated enterprise with the potential for overexploitation. Philip A. Medica (National Biological Service, Las Vegas, pers. com.), has urged setting bag limits on species commonly collected for the pet trade to avoid jeopardizing their continued survival by rampant commercial collecting. Until recently, the chuckwalla was a category 2 candidate for listing under the Federal Endangered Species Act, but no data were available for population trends in Nevada. According to D. B. Hardenbrook (pers. com.), the Nevada Division of Wildlife therefore sought and received financial support from the U.S. Fish and Wildlife Service and the Clark County Desert Conservation Plan to conduct a study of chuckwallas. The study, currently under-

way, was contracted to Utah State University (E. D. Brodie, Jr., principal investigator) to determine: 1) the distribution and population status, and 2) regional habitat characterization and habitat use relationships. Analysis of commercial harvest data will be included as part of the study.

Unfortunately, like other species, chuckwallas are subject to illegal trafficking. According to one U.S. Fish and Wildlife Service agent (Anonymous, pers. com.), dealers suspected of possession and sale of illegal Arizona or California chuckwallas usually claim their origin as Nevada. Thus, law enforcement is currently stymied by the ability of unscrupulous dealers to "launder" their illegal lizards. Future law enforcement may be aided, however, with publication of a study by B. D. Hollingsworth which, in part, deals with geographic variation in color pattern of the common chuckwalla. Based on his unpublished research (Hollingsworth, 1995) the "northern speckled" chuckwalla occurs in most of southern Nevada and is the primary pattern class subject to legal commercial harvest. However, this pattern class also occurs in a portion of the Mojave Desert of California, rendering populations there vulnerable to illegal collecting. Several other chuckwalla pattern classes, including the melanistic with white or yellow tail, melanistic with orange-red tail, and partially melanistic (with yellowish or brick-red midbody), occur in Arizona and/or California, and cannot be legally collected for commercial trade.

Unlawful commercial collecting is occurring in Arizona, and probably in California as well, and the strict bag and possession limits imposed by both states, unfortunately, are easily circumvented by individuals who sell to commercial dealers. According to several sources (Anonymous, pers. com.), these collectors often work in groups, each person collecting his bag limit and then mailing the catch to a destination out of state. The process is repeated several times each day, until a hundred or more lizards have accumulated for sale to a dealer.

Evidence of violations of state regulations is common. One individual with 30 chuckwallas in his possession, claimed to have misunderstood the stipulated bag limits for Arizona (Anonymous, pers. com.). In 1987, melanistic chuckwallas with the orange-red tail, a pattern class confined to a single mountain range (also a municipal park) in Arizona, were being offered for sale by a dealer in New York (R. Montanucci, pers. obs.). In 1994, several hobbyists visiting a south Florida reptile dealer saw between 50 and 100 of these chuckwallas in the dealer's warehouse (Anonymous, pers. com.). In the spring of 1996, a troop of boy scouts discovered two large bags stashed under some boulders; each contained 30 to 40 melanistic, orange-red-tail chuckwallas (Jeffrey Howland, pers. com.). The chuckwallas were released by park officials, but some mortality probably occurred because the lizards were displaced from their territories. Responding to the commercial threats against this restricted and uniquely patterned chuckwalla, the Arizona Game and Fish Department closed season on the population in 1997.

In Mexico, illegal commercial collecting of common chuckwallas is presumably negligible because they are similar to various populations in the U.S., or sufficiently unremarkable so as not to be sought. However, the giant insular chuckwallas, *Sauromalus hispidus* and *S. varius*, are impressive, highly prized profitable species for the pet trade, and despite protected status, there has been a substantial level of commercialization (Mellink, 1995; this study). In recent years, *Sauromalus hispidus* has been unlawfully imported into the U.S., appearing at reptile breeders' expos or at dealers in California, Colorado, Florida and Oregon. Thus far, commercial collecting appears to have had little impact on the populations, and *S. hispidus* remains abundant on 11 islands in the Gulf of California (Mellink, 1995). The species is also now being successfully propagated by one private breeder (Gray, 1995). *Sauromalus varius* is less commonly available, but has been offered for sale by at least one dealer in California (Anonymous, pers. com.).

Aside from the domestic trade in common chuckwallas, large numbers continue to enter the European pet market. In The Netherlands, for example, chuckwallas are now widely available at low cost (Bert Langerwerf, pers. com.). Whether domestic and foreign trade in these lizards will increase substantially in the coming years is difficult to predict. In any case, commercial collecting is a gross and wasteful enterprise; the hundreds of lizards (and other reptiles) crowded in bins at dealer warehouses raise both ethical and ecological concerns. Wild-caught reptiles of all species experience high rates of mortality and morbidity under such stressful conditions. Commercial collecting, next to habitat destruction, is the most serious threat to most wildlife populations, and the potential for overexploitation should not be underestimated. In fact, for reptiles that are endangered, threatened or rare, overexploitation (including commercial trade of the animals or their products) threatens 63 percent of the species, while habitat loss affects 53 percent (Reid and Miller, 1989).

The current level of illegal trade involving *Sauromalus obesus* from Arizona and California cannot be assessed, but the few examples mentioned here are disturbing and suggest a growing problem. Reclassifying the chuckwalla in Nevada as a noncommercial, protected species would, I believe, all but eliminate domestic and foreign trade in these lizards, and allow Nevada populations to recover. On the other hand, continued, unregulated harvest in Nevada is likely to result in localized extinctions of accessible populations and the increased temptation of commercial forays into Arizona and California. In my opinion, commercial trade should be restricted to captive-bred species, with a mechanism to allow importation of limited numbers for breeding purposes only. Otherwise, commercial trade in wildlife should be eliminated entirely. But hobbyists should be allowed to collect chuckwallas and other common species, and this can be accomplished on a sustainable basis through sound management principles. Regardless of what steps, if any, are taken to protect chuckwallas and other species of native herpetofauna, amateur and professional herpetological societies must ensure, through individual awareness and concern (and peer pressure!) that state wildlife laws are followed.

Acknowledgments

I want to thank the following people for providing some of the chuckwallas used in this research, and/or assisting in the field: Jay Chance, Jerrold J. and Martin J. Feldner, Jimmy

McGuire, Tony Mills, Lester Milroy III, Regis Opferman and Jeff Wines. Several persons shared with me their experiences with keeping chuckwallas, including James Edwards, Howard E. Lawler, Julie Layton and Thomas Porter. I am especially grateful to Scott Pfaff (Riverbanks Zoological Park, Columbia, SC) and Gerard Visser (Royal Rotterdam Zoological Garden, The Netherlands) for generously providing data on chuckwalla reproduction. I also thank Richard D. Bartlett, Bertrand Baur, David H. Lewis and Jeff Wines for favors and technical help. Bert Langerwerf (Agama International, Inc.) kindly translated Schiberna's article, and offered his insights into the complexities of breeding lizards. Arizona Game and Fish Department (Jeffrey M. Howland), California Department of Fish and Game, Nevada Department of Wildlife (Brad Hardenbrook), and Utah Division of Wildlife Resources provided information on state regulations pertinent to collecting amphibians and reptiles. I also thank Allison Alberts and John Iverson for critically reading a previous draft of this paper, but their endorsement of my views is not implied. Chuckwallas were collected in California under scientific permit nos. 0301 and 9044. Lizards in Arizona were taken under a nonresident hunting license.

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HerPET-POURRI

by Ellin Beltz

Declining amphibians down under

• "On June 13, 1996, a tunnel pipe was placed across and under the [Waitakere Ranges Scenic Drive in the cloud zone] as a frog crossing. . . . Maybe some [endangered *Leiopelma hochstetteri*] use it, but the majority choose a more direct route to cross from one side of the road to the other. They by-pass the tunnel and its good intentions. Usually theories are expressed at the disappearance worldwide of frogs, it is usually seen as a loss of habitat, or environmental pollution. This is a much more obvious issue: Traffic on the Scenic Drive . . . is inadvertently killing an endangered frog species. Isobel Bruce" [*MOKO*, New Zealand Herpetological Society Newsletter, Autumn, 1997 (our spring—wish they'd use month names!)]

• Roundup, a widely-used herbicide, has been implicated in some Australian frog declines reports Michael Tyler of the University of Adelaide, South Australia in the March 1997 issue of *Froglog*: "The Australian Government has . . . banned 84 herbicide products from use near water because of their impact upon frogs and tadpoles. All of these products, of which Roundup (Monsanto) is the best known, contain glyphosate as the active ingredient. However, there is agreement that it is not the glyphosate that is the principal problem but a detergent additive termed a dispersant or wetting agent. The function of the dispersant is to break down the surface tension at the leaf surface, so that the individual spray droplets disperse to completely cover the leaf. Unfortunately, all detergent compounds interfere with cutaneous respiration in frogs and particularly gill respiration in tadpoles. Impact may very with water temperature because oxygen saturation decreases with temperature. . . . The use of these herbicides near water is already banned in the UK and USA."

Horny lizard people needed

The Texas Parks and Wildlife Department has started a "Texas Horned Lizard Watch" program in an effort to find the cause (or causes) of the decline of *Phrynosoma* in that state. Call (800) 792-1112 to volunteer. The program will provide maps and instructions on lizard monitoring. [*Texas Parks and Wildlife Magazine*, May 1997, from Mark Witwer]

Shopping as art

True Shoposaurs probably already know this, but the John G. Shedd Aquarium has a new gift shop called "Go Overboard!" on their main floor. You have to see it to believe it. Different environments with themed merchandise surround a huge 3-D octopus with tentacles wrapped around eight columns which themselves surround the kiddy play area full of interactive stations and toys. For shopping as make-believe, this store even outdoes FAO Schwartz and Nike Town. If you get to Water Tower Place in June, don't miss the frog displays courtesy of the Aquarium. You can get a 10 percent discount coupon for "Go Overboard!" at any WTP information desk. [*WaterShedd*, May 1997, from Karen Furnweger]

Alligator news: The good, the bad and the ugly

• Farmers in Florida's booming $2.1 billion/year poultry industry are feeding alligators the carcasses of the average six percent of captive chickens lost to natural causes each year. The former disposal options were incineration, burial and composting. Poultry farmers find that alligators are cheaper—and can be sold for profit, too. [*The Advocate*, Baton Rouge, LA January 2, 1997, from Ernie Liner]

• "Golden Gator" captured in San Francisco's Presidio Park was released into the Louisiana bayou. "The fuss amused many Louisianans. In this part of the country, people are more used to trapping, shooting and eating alligators. Their skin makes nice belts and high quality boots. Their skulls are sold as tourist trinkets in the French Quarter," reports Rebecca Rolwing, writing for the Associated Press.

• Only 548 tags of the 26,548 alligator permits issued in last September's Louisiana alligator season weren't filled. It was the third largest harvest since 1972. The average alligator killed was seven feet long, but this year, the price was down to only $25 a foot from a high of $37 in 1994. The price drop has been blamed on oversupply of skins from foreign countries as well as from domestic alligator farms. [*The Courier,* Houma, LA, December 26, 1996, from Ernie Liner]

• Kids feeding an alligator raw meat in Winter Garden, Florida, accidentally sentenced a 13-foot alligator to death. When authorities heard about the feeding, they had the gator trapped and destroyed because it would no longer fear humans. The children had jumped a fence surrounding the pond to feed the gator. [Orlando, FL *Sentinel*, February 3, 1997, from Bill Burnett]

• A 6-year-old child in Baton Rouge found a 2-foot alligator with its mouth taped shut right after it had been run over by a car. Authorities speculate that someone was transporting the gator when it fell off a truck. The child tried to save the gator. Animal control officers who took it to the shelter said its survival was unlikely, but that they would try to get it healthy enough to release in the nearest bayou. [*The Courier,* Houma, LA, April 29, 1997, from Ernie Liner]

• "Dozens of alligators at the St. Augustine Alligator Farm are dying of a mysterious disease. . . . A bacterial infection has killed more than three-fourths of the alligators that have been exposed to the disease. . . . Many were more than 60 years old, 11 or 12 feet long and weighed 700 or 800 pounds." [Leesburg, FL *Daily Commercial*, March 1, 1997, from Bill Burnett]

• Two young brothers were reportedly allowed to play with minimal supervision with the family dog in shallow waters at Lake Ashby, Florida, when a sudden splash alerted their parents that not all was well. The mother found her 8-year-old and the dog, but the 3-year-old was missing. An "army" of searchers descended on the lake, helicopters buzzed overhead, a command center was set up—but no trace of the child was

found until a day later when the boy was found dead adjacent to the alligator which is believed to have killed him. A trapper killed the 11-foot, 450 pound alligator. The mother said she'd never have let the boy play in the water if she had known there were alligators there. The park has no warning signs because authorities say that alligators are known to be found in every body of water in the state. [March 22, 1997, *Democrat-Gazette*, Little Rock, AR, from Bill Burnett; March 23 *Chicago Tribune*, from Sam Restich; *Albuquerque Journal*, from J. N. Stuart]

Jeremiah was a bullfrog?

A preacher in Orestes, Indiana, takes his pet bullfrogs (*Rana catesbeiana*) along to old folks homes and hospitals. Seems if he asks you to take a "leap of faith," he's got a live, demonstrator for that concept. Elderly people enjoy holding the big amphibians, listening to the preacher has he ministers and singing along while he plays his harmonica. [Bucyrus, OH *Telegraph-Forum*, c. March, 1997, from Bill Burnett]

Bad news for greens

Scientists report that more than 50 percent of green turtles in the Indian River in South Florida are infected with fibropapilloma, a disease which covers the turtles in tumors. Eventually unable to see to feed, tumorous turtles starve to death. Karen Bjorndal, director of the University of Florida's Archie Carr Center for Sea Turtle Research, said that the "smoking gun of human contact with the environment" appears to be agricultural chemical runoff. [Leesburg, FL *Daily Commercial*, February 3, 1997, from Bill Burnett]

Salmonellosis from iguanas up

The Centers for Disease Control and Prevention report in the March, 1997 issue of "Pediatrics" that iguana-linked salmonella cases are on the rise. In 1995, 67 cases were reported - the first case ever was reported in 1989. Doctors warn that salmonella infection can lead to meningitis and other serious complications in infants and people with compromised immune systems. One fatality, a 3-year-old Indiana child, was reported in October 1995. [New Orleans, LA *Times-Picayune*, March 11, 1997, from Ernie Liner]

Primitive snake recognized

Reappraising a 95-million-year-old fossil found in an Israeli limestone quarry, researchers noted that the supposed lizard was actually an extremely primitive snake with two tiny hind limbs. While living species of snakes (like boas) have vestigial hind limbs, the fossil is more related to oceanic lizards such as *Mosasaurus* which roamed the southern oceans about 250 million years ago. In the last century, Edward Drinker Cope, a prominent American herpetologist proposed a link between snakes and mosasaurids, but his proposal was roundly rejected by other scientists who believed that snakes developed from a group of burrowing lizards. [*The New York Times*, April 17, 1997, from Mark Witwer]

I'm breathing and I'm screaming II

Hollywood strikes again with *Anaconda*, which has been making a lot of money with a bunch of hooey about snakes. The guy who knows about snakes describes the title snake as "the perfect killing machine . . . it strikes, wraps around you, holds you tighter than your true love, and you get the privilege of hearing your bones break before the power of the embrace causes your veins to explode. Then it swallows you whole." Wrong. In the course of a research project which bagged more than 450 anacondas in a mark-and-recapture study, reported in last year's *Smithsonian Magazine*, workers report essentially no problems other than those expected while dealing with animals which can be up to 20 feet long. Not one human predation has been reported for the species, unlike the Asian python which has taken several *Homo sapiens* usually in artificial situations. [*Philadelphia Inquirer*, April 21, 1997, from Mark Witwer]

More skins

An article in the April 1997 issue of *Fur-Fish-Game* details how to catch, kill, skin and sell rattlesnake hide. As usual, the advice includes getting a sprayer full of gasoline (although it suggests "checking state regulations" first) and shooting the animals with a .22 (although not while coiled as that ruins the skin). For once, the bite advice is accurate: go straight to a hospital—do not apply tourniquet, ice, suction or other folk remedies. [from John Levell]

More snakes

- A woman hand-feeding her pet python nearly became chow. Eustis, Florida, police responded to the call and used pepper spray to persuade the python to let go. [Leesburg, FL *Daily Commercial*, February 8, 1997, from Bill Burnett]

- Copperbelly watersnakes (*Nerodia erythrogaster neglecta*) from northern Indiana, Michigan and northwestern Ohio have been put on the U.S. federal endangered species list. However, the snake has populations in Illinois, southern Indiana and Kentucky. In those areas, coal companies, agriculturists and the government have reached an agreement to protect snake habitat while not protecting individuals of the species. [*The Cleveland Plain Dealer*, from Jim Zimmerman; *The Times-Picayune* from Ernie Liner; both February 26, 1997]

- The President asked for $1.5 million for brown tree snake (*Boiga irregularis*) control on the island of Guam where the species has eaten its way through the local fauna, caused power outages, reportedly been found in baby cribs and is so abundant that officials are afraid it will be accidentally transported to other islands (including Hawaii). Tom Fritts of the Interior Department said, "What's at stake is the ecology of many islands in the Pacific. . . . [It's like a bomb.] The question is, when is it going to go off, causing ecological, economic and sociological damage?" [*Honolulu Advertiser*, February 17, 1997, from Sean McKeown]

- A 10-foot python escaped in Sioux Falls, South Dakota, by breaking the glass in its aquarium and pushing aside 60 pounds of weight which had been placed on the top of the tank. The snake wrapped itself around its 18-year-old owner and it took three people to get it off again. [*The Chicago Tribune*, March 2, 1997, from Ray Boldt]

• One man in western Kentucky near the Ohio River "said he had shot so many snakes [escaping the flood] that he was nearly out of ammunition for his .22-caliber rifle." [Louisville, KY *Courier-Journal*, March 13, 1997, from E. A. Zorn]

• The Bonnet Carre Levee Spillway was opened to provide an outlet for Mississippi River waters earlier this year. After that, so many snakes were spotted in Lake Ponchartrain that the local police issued an advisory aimed at bikers, rollerbladers and picnickers to be on the lookout for reptiles. Alligators are also a possibility, according to police officers. [*The Times-Picayune*, March 22, 1997, from Ernie Liner]

• An 8-foot-long, 25-pound Burmese python was found by a sewer inspector in Maryville, Tennessee, last year. Animal Control had the snake X-rayed because of the big bulge in its middle and found that it had eaten a duck. The snake was later claimed by a man who said that he had lost the Burmese and an even larger boa constrictor from his garage about two months before the python was found. [October 15, 1996, *The Daily Times*, Maryville, TN; October 13 *Knoxville News-Sentinel*; both from Ernie Liner]

Quite a range extension

A worker at a concrete plant near Auckland, New Zealand, was amazed when what he thought was an odd-colored rock turned out to be a turtle. Zoo officials were surprised, as well. The turtle was an American red-eared slider (*Trachemys scripta*). [*MOKO*, New Zealand Herpetological Society Newsletter, Summer 1996/97]

You may not want the CD

Five drag queens formed a "porno rock band" called "The Sea Snakes." They are touring the U.S. as well as working on a CD that reportedly insults every convention of polite society. As this is a family magazine, no further explanation will be offered, but let's just say that even the fertile imagination of Jeff Beane ("Twisted *Sistrurus*") might have difficulty with some of the Sea Snakes' stunts and lyrics. [*Daily Lobo* (University of New Mexico), May 1, 1997, from J. N. Stuart]

Fatal fire kills eight pets

Two alligators, three turtles and two snakes survived a fire in their Fayetteville, Arkansas, home, but eight other reptiles weren't so lucky. Their owner was not home when the fire was reported by the owner of "Lil' Shoppe of Horrors" a neighboring body piercing and tattooing parlor. The fire appears to have begun on a mattress, but the cause was undetermined, according to authorities. The animals were being kept under permit, according to the owner, but his permits burned up in the fire. [Little Rock *Arkansas Democrat-Gazette*, April 4, 1997, from Bill Burnett]

Contributors write . . .

• Brian Bankowski: "I saw more iguanas around the swimming pool [in Aruba, Dutch Antilles] than I did in two weeks of slogging the jungles of Costa Rica. . . . The turquoise, white-spotted ameivas are everywhere. You'd love it here." [Postcard from vacation]

• Bill Burnett: "Who lets their kid go into any body of water in Florida unsupervised? . . . Gators are everywhere in Florida!" [March 29, 1997 letter]

• Sherman Minton: (autograph on copy of 'Bites by non-native venomous snakes in the U.S.') "[There's] a message here for some amateur snake keepers. . . . In most nations, snakebite is a disease of the rural agricultural population, and the reptiles . . . are part of the . . . native herpetofauna. . . . A significant number of snakebites [in some Western nations] are caused by [non-native] snakes kept in captivity. . . . In a 1959 survey . . . only seven of 6680 venomous snakebites were inflicted by non-native species. . . . [Since then there have been nearly 60 bites by exotic venomous snakes and 106 bites by native species. Half of the people bitten were keeping or trying to catch the animals.] Clearly, keepers and hunters of venomous reptiles make up a well-defined high-risk group. . . . Of the 51 individuals . . . bitten by [exotic venomous snakes] 47 were adult males and four adult females. . . . Three . . . were bitten twice by exotic snakes during a two-year period; one of them sustained a third bite by a native snake." [*Wilderness and Environmental Medicine* 4:297-303, 1996] On the scary side, Dr. Minton notes that there are no antivenoms for some of the exotics now finding their way into amateur collections as "rarities." In addition, some people envenomated did not know (or record) the scientific name of the animal which bit them. This omission could retard or stop the application of antivenin by hospital personnel fearing malpractice should the snake turn out to be a different species.

Thanks to everyone who contributed to this month's column and to Ernie Liner, Mark Witwer, Garret Kazmierski, Bill Burnett, Kathy Bricker, Ray Boldt, J. N. Stuart, Jack Schoenfelder and P. L. Beltz for stuff I enjoyed reading (sometimes several times as the same story bounces around the nation). You can contribute too! Send whole pages of newsprint, magazine, newsletter, etc. with your name on each piece to: Ellin Beltz, 1647 N. Clybourn Avenue, Chicago, IL 60614-5507 or e-mail letters only to <E-Beltz@neiu.edu>. Please fold a minimum number of times, omit staples, use tape if you must affix pieces together and use the largest envelopes available to help reduce my "origami" load! Thank you!!!!

Unofficial Minutes of the CHS Board Meeting, May 16, 1997

The meeting was called to order at 7:52 P.M. Board members Greg Brim, John Driscoll, Ron Humbert and Jack Schoenfelder were absent.

Officers' Reports

The minutes of the April Board of Directors meeting were read, corrected and accepted.

The Treasurer's report was distributed and accepted.

Committee Reports

1997 ReptileFest: Lori King-Nava handed out and discussed the last chapter in the "ongoings" of the event.

Grants: The CHS Herpetological Grants for 1997 have been awarded. Recipients will be announced in the June *Bulletin*.

Library: Jenny Picciola has made a list of the people who have overdue books and will announce them at the general meetings.

Shows: The following shows are scheduled: The Little Red Schoolhouse, June 8; Windy City Pet Expo at McCormick Place, October 11-12 (members who will be displaying their animals will be by invitation only—see Jenny Vollman); and the Chicago Academy of Sciences, September 20-21. The CHS liability insurance has been renewed for the coming year.

Old Business

Book inventory: There will be a special Board of Directors meeting at Mike Dloogatch's office on Thursday, May 22, at 7:30 P.M. to discuss and finalize the disposition of the CHS book inventory.

Round Table

Lori King-Nava and Steve Spitzer were on WGN Radio on a children's call-in talk show on May 3. They also, of course, plugged ReptileFest.

Jenny Picciola has been sending out thank-you letters to CHS raffle donors.

Mike Dloogatch reported that long-time member Tom Zaremba has donated a set of framed herp photos for our raffle.

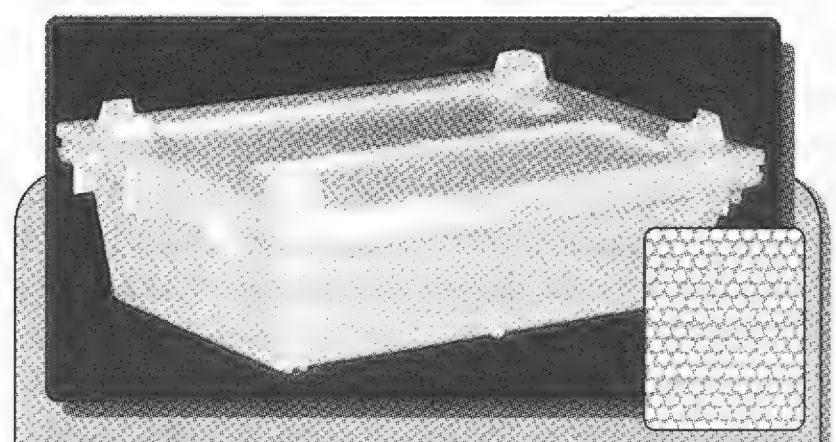
Steve Spitzer thanked all those who attended the membership committee meeting and wanted to remind all of us to start thinking about this year's nominations. Steve also announced that the Turtle Club had a Show and Tell meeting last month that went very well.

The meeting adjourned at 9:10 P.M.

Respectfully submitted by the Recording Secretary
Audrey Vanderlinden

Health Food for your herps!

Highest quality rodents are available in all sizes from pink mice to jumbo rats. Fresh frozen crawler mice are only 17¢ each in lots of 2,000. All frozen animals are shipped in insulated boxes.



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American Federation of Herpetoculturists: A nonprofit national membership organization of herpetoculturists, veterinarians, academicians and zoo personnel involved in the captive husbandry and propagation of amphibians and reptiles. Membership includes highly acclaimed magazine, *The Vivarium*, dedicated to dissemination of information on herpetocultural accomplishments, herp medicine, breeding and maintenance, field studies and adventures, enclosure design and much more. AFH membership is $26. Send information requests to: AFH-News, P.O. Box 300067, Escondido CA 92030-0067.

For sale: rats and mice—pinkies, fuzzies and adults. Quantity discounts. Please send a SASE for pricelist or call Bill Brant, *THE GOURMET RODENT*, 6115 SW 137th Avenue, Archer FL 32618, (352) 495-9024, E-mail <GrmtRodent@aol.com>.

For sale: murine-pathogen-free rats and mice available in all sizes, live or frozen: pinkies, fuzzies, crawlers, small, medium and large. Frozen crawler mice in lots of 2000, $.17 each. Also available, full grown hairless mice. FOB shipping point. Master Card accepted. Call (518) 537-2000 between 8:00 A.M. and 5:00 P.M. or write SAS Corporation, 273 Hover Avenue, Germantown NY 12526 for prices and additional information.

For sale: high quality feeder mice. Shipped UPS Next Day Air. All mice are properly processed to insure a quality product. Fourth year of production and supply of frozen feeder mice. Prices: pinks, $25/100; fuzzies, $30/100; weanlings, $35/100. Also available are 4 oz.+ rats, $100/100. Quantity discounts available. The Mouse Factory, P.O. Box 85, Alpine TX 79831, (915) 837-7100, Ray Queen.

For sale: from Bayou Rodents, excellent quality feeder mice and rats. Every size available. Pinks starting at $20/100. Orders are shipped by overnight service Monday thru Thursday. We accept Visa, MasterCard and Discover. For more info, contact Rhonda or Peggy, (800) 722-6102.

For sale: **high quality frozen feeders**. Over a decade of production and supply. Seven sizes of mice availabe: small newborn pinks up to jumbo adults. Prices start at $25 per 100. Feeders are separate in the resealable bag, not frozen together. Low shipping rates. Free price list. Kelly Haller, 4236 SE 25th Street, Topeka KS 66605, (913) 234-3358 evenings and weekends.

For sale: In stock, Flex-watt and Ultra-therm heating products. **Frozen rodents** always available. Mice: pinks–crawlers, 3/$1; weanlings, 40¢; subadult, 50¢; adults, 65¢; large adults, 75¢. Rats: small, 85¢–$1; medium, $1.25–2.00; large, $2.25–2.75; jumbo, 3/$10. Call on quantity discounts [note: discount on orders picked up at CHS meetings]. Live rodents available at higher prices. **Available now**: newsletter/catalog—many unique/hard-to-find herp husbandry items. Send business-size SASE for catalog, or call. Scott J. Michaels, D.V.M, Serpent City, P.O. Box 657, Island Lake IL 60042, (815) 363-0290.

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For sale: Herp bags—colors vary, translucent ripcord nylon, super lightweight, extremely durable construction with hot corners sewn in, double seamed. Custom sizes made upon request. Sizes: 46" × 14", $7 each; 24" × 12", $6 each; 24" × 6", $5 each. Shipping fees, $1 for first bag, $.30 each additional bag. Nicole Lechowicz, 290 Warren Road, #69, Carbondale IL 62901, (618) 457-2783.

For sale: handcrafted miniature cartoon-like sculptures of any herp. Refrigerator magnets, desk ornaments, paperweights, earrings, pins etc. You name it—I'll make it. Prices vary. Dave Golde, (847) 679-1530.

For sale: April 1997 release. *Captive Husbandry and Propagation of the Boa Constrictors and Related Boas* by David Fogel (Krieger Publishing). The most comprehensive volume on the subject. All major captive care considerations are addressed allowing the keeper of any boa species to provide for, and poosibly breed their captives. Comprehensive chapters on heating devices and their application to herpetoculture, and designing a herp room will be extremely beneficial for everyone maintaining any species of reptiles or amphibians in captivity, as well as the boa keeper. Hard cover with dust jacket, 60 color and 14 b&w photographs, over 100 pages. Signed or personally inscribed (provide instructions with order) copies are available from the author for $33.50 each plus shipping ($2.50 for the first copy and $1 each additional copy). Send money order or check to: David Fogel, The Herp House, 1750 Haines Road, Orwell OH 44076, (216) 685-4615 phone, (216) 685-4572 fax.

For sale: *TURTLES*, the critically acclaimed book by Anita Baskin-Salzberg and Allen Salzberg. Only $20, postage and shipping included. This is the book "Herp Review" as well as "Chelonian Conservation and Biology" called one of the most accurate and beautiful on turtles for children to come along for a long time. If not for you, or your child, consider donating *Turtles* to your local school or children's library. It's tax deductible. Just send your check to A. Salzberg, 67-87 Booth Street -5B, Forest Hills, NY 11375. We'll autograph it upon request.

For sale: **Reptile cage plans**. Finally, an easy and inexpensive way to build your own cages. Choose from four different plan sizes. Small (24 × 24 × 24), Medium (48 × 24 × 24), Large (48 × 24 × 36), or Extra-large (72 × 24 × 36). Based on width × depth × height (in inches). Each set of plans comes with complete instructions, parts list, detailed assembly instructions, and a figure of a completed cage. Plans are $8 each, or all four plans for $24. Also available, electric line thermostats. Easy to use and install. Takes minutes and installs directly into the electric line that feeds your heat lamp. Only $30. Please mail orders to Tait Kjellberg, P.O. Box 72087, Davis CA 95617.

For sale: three Neodesha cages. Jim McDermott, (708) 425-1152.

For sale: Entire sideneck turtle collection. Siebenrock's sideneck (*Chelodina siebenrocki*), $150 each; matamatas (*Chelus fimbriatus*), $1500 for breeding pair; New Guinea snappers (*Elseya novaeguineae*), $60 each; red-bellied short-necked (*Emydura subglobosa*), $60 each; Gibba turtle (*Phrynops gibbus),* $120 for pair; spotted-bellied sideneck (*Phrynops hilarii)*, $60 each; common toad-head (*Phrynops nasutus*), $150 for breeding pair; giant toad-head, (*Phrynops ranicepes*), $200; Orinoco River turtle (*Podocnemis vogli*), $200 each; plus more. Call or write for list. Phil Drajeske, 8012 Greenwood Avenue, Munster IN 46321, (219) 838-8032.

For sale: available now! **Tortoises:** Aldabras, 3–4" captive hatched; redfoots, beauties, $125 each. **Boas/pythons:** young adults/adults. Three male and three female Children's, reddish desert phase, females *gravid* and have produced 11–20 eggs each in the past; two male and one female Australian olives, 10–12', adults, proven breeders, $1500/trio; two male and one female Mardarin *Sanzinia*, males 6–7', female 8–9' and approx. 20 lbs., with CITES, $5500/trio; one male and one female Bolivian redtails (*amarali*), 6–7', nice, heavy-bodied, proven breeder, $2750/pair; two male and one female Hog Island boas, proven breeder male has fathered eight litters in the past few years, the remaining pair are subadults, $1000/trio; two male and two female rough-scaled sand boas, adults, beauties, both females probably gravid, $300/pair; two male and two female Amazon emerald tree boas, nice markings and color, long-term captives, $2500 each; one male and one female green tree pythons, nice light green, light blue and white, adults raised from young, $900/pair. Dick Goergen, P.O. Box 225, Alden NY 14004, (716) 681-4518.

For sale: **c.b. "vittikins" bearded dragons** (*Pogona vitticeps* × *P. rankini*). Smaller than standard bearded dragons. Perfect size pets! Healthy red phase babies born 5/14/97, $30. Also **c.b. leopard gecko babies!**, normals, $20, high yellows, $25; **c.b. Jackson's chameleons**, $30. All the babies are well started and available to good homes only! See Audrey Vanderlinden at CHS or call (773) 561-9003. **NOT a commercial breeder**.

Advertisements (cont'd)

For sale: c.b. geckos—Seychelles Islands day geckos (*Phelsuma astriata semicarinata*), $65 each; giant day geckos (*P. madagascariensis grandis*), one male and one female breeding adults, $50/pair, juveniles, $15 each; ornate day geckos (*P. ornata*), $35 each; velvet geckos (*Oedura monilis*), high yellow phase, $75 each; New Caledonia gecko (*Rhacodactylus auriculatus*), several bloodlines, $135 each; one male and three female big-headed geckos (*Paroedura pictus*), breeding adults, $80/group; high-yellow phase leopard geckos, $30 each. Philip Tremper, P.O. Box 264, Clintonville WI 54929, (715) 823-5873.

For sale: two spiny-tailed monitors (*Varanus acanthurus*), c.b. '96, very pretty, $500 each; one male and two female *Paroedura*, new subspecies from Madagascar, very nice, 6", well established breeders, $175 each; one male and two female Crawl Cay boas, c.b. '93, very rare, unique, miniature boa constrictors, adults are 3½–4', ready to breed, $2100/trio; one male and two female Hog Island boas, c.b. '96, white/light gray with quantities of bright pink and orange, gorgeous, $350 each; one male and one female Amazon tree boas, breeders, average color, produced yellow babies, $200/pair; 4' male jungle carpet, c.b. '94, Sipperley stock, nice black, average yellow, $200; one male and one female carpet pythons, c.b. '93, 6'+, average color, $550/pair. Expecting: smooth knob-tailed geckos (*Nephrurus l. laevis*), parents are nice red with great personalities, good investment, $1000 each; *Rhacodactylus ciliatus* from red/gold adults, $250 each. Chris Jackson, (619) 265-7557 phone/fax.

For sale: captive-bred panther chameleons (*Chameleo pardalis*), juveniles (up to 6 months old) and hatchlings available, two color phases (Ambanja blues and reds) available, extremely healthy offspring from gorgeous parents, Ambanja blues $100 & up, red phase, $75. Quantity discounts available. Brian, (414) 672-4211. [WI]

For sale: captive-bred snakes, lizards, tortoises, and amphibians. Prospective births and hatchlings include: leopard geckos, Jackson's chameleons, carpet chameleons, African spurred tortoises, rat snakes, king snakes, milksnakes, black and northern pine snakes, western hognose snakes (permit needed in Illinois), African house snakes, spotted pythons, Macklot's pythons, Colombian boas, Brazilian rainbow boas. Also feeder mice available in quantities with rats coming soon. Send SASE for current price list or call/fax (903)693-3379 or E-mail <bobball@panola.cc.tx.us> R. L. Ball, 226 N. St. Mary Street, Carthage, TX 75633.

For sale: Jungle carpet pythons, beautiful yellow on velvet black. Also, Borneo blood pythons, Argentine boas, northern bluetongue skinks, rosy boas. All captive born, gauranteed healthy and feeding well. Some adults available also. Bill Montgomery: (512) 285-9631 (evenings) or (512) 285-5520 (leave message). [TX] E-mail: Tiliqua@aol.com

For sale: from **Diversified-Genetics** . . . Superior bloodlines of captive-bred snakes. Are you tired of buying snakes whose family trees go "straight-up"? I am a small private breeder (hobbyist for 25+ years) who is absolutely dedicated to providing you with the finest in strong, genetically diverse, outcrossed bloodlines. The end result of all of this is very simply that the animals that I am producing are good strong babies! Boa constrictors (albinos and possible heteros born 5/10/97); Burmese pythons (cinnamons, green patternless, cinnamon green patternless and possible heteros due 6/97); patternless northern pines (recessive mutation from pure northern stock, first time offered in U.S., available now); Sonoran desert kings (heterozygous for hypomelanism, due 7/97). Many others, free price list. Steven E. Snow, **Diversified-Genetics**, P.O. Box 544, Rockton IL 61072, (815) 624-8204.

For sale: **Chondros, Chondros, Chondros!** Ophiological Services is ready to provide you with your own captive-born green tree python from the world's largest and most diversified genetic collection of green tree pythons, second to none. All animals are very well established with data cards, genealogy charts, and scientific reprints. Available for sale are babies, juveniles and 1–2 year olds. Other pythons, boas and colubrids available. Eugene Bessette, (352) 495-3075 phone, (352) 495-2952 fax, (Archer FL). We accept Visa and MasterCard.

For sale: expecting in '97. Black & white northern pine snakes (*Pituophis m. melanoleucus*) from Bart Bruno's snowball bloodline and an unrelated female, all are New Jersey stock, $100/pair; albino Sonoran gopher snakes (*P. catenifer affinis*), lemon yellow and candy apple red, $80/pair, heteros, $30/pair; Taiwan beauty snakes (*Elaphe taeniura friesei*), bright yellow, large and docile rat snakes, $100/pair. Craig Roehm, P.O. Box 10834, Erie PA 16514, (814) 455-5246.

For sale: **Sinaloan milksnake**, 2-year-old female, $75 o.b.o.; **desert Cal king**, 6-month-old female, $35 o.b.o.; **red-footed tortoise**, 1-year-old, $150; **African fat-tailed geckos**, $40 each or $100 per trio of one male and two females. Marc, (630) 243-9758.

For sale: c.b. '97 snakes. Ghost corns, $25 each; Cal kings, some aberrant, striped and banded, $25 each. Joe, (708) 450-1614.

For sale: wide variety of captive hatched/produced reptiles from reputable breeder. Animals are from hand-picked adults with diverse bloodlines. **Milksnakes**: Jalisco milks, $90; Honduran milks, $75; tangerine Hondurans, $85–100; Pueblan milks, $55–70; Nelson's milks, $75; Sinaloan milks, $60; Mexican milks, $50. **Kingsnakes**: Mexican black kings, $40; desert kings, $35; Mexican mountain kings (*knoblochi*), $225–400; Arizona mountain kings (*woodini*), $75–90; San Pedro mountain kings (*agalma*), $225; *thayeri*, $75–100; melanistic *thayeri*, $100; "*mex mex*," $75; gray-banded kings, $100. **Other snakes**: boas, $75; albino striped Pacific gophers, $60; black pines, $75; western hognose, $30 [permit needed in Illinois]; regular corns, $12.50; amelanistic corns, $22.50; snow corns, $25; regular banded Cal kings, $20; albino banded Cal kings, $25; lavender phase albino Cal kings, $35. All animals are feeding on "unscented" mice unless otherwise indicated and have fed at least two times before shipping. Call for quantity discounts. Troy, (573) 642-9422. [MO]

For sale: 1997 hatchlings. Trans-Pecos rat snakes, Mexican hognose [permit needed in Illinois], red milksnakes, $35 each; Baird's rat snakes, prairie kings, California kings, $25 each; Mexican milksnakes, Pueblans, albino speckled kings, $50 each; *ruthveni*, $75 each; *thayeri*, graybands, Durango mountain kings, $100 each; Arizona mountain kings, $125 each. Steve Mitchener, Oklahoma City OK, (405)748-6566 after 6 P. M. Central Time.

For sale: beautiful, feeding snakes. Wholesale quantities to dealers, individual purchases welcome. Send SASE for **free** price list. Robert Applegate, P.O. Box 338, Campo CA 91906, (619) 478-5123. Also, free phone consultation on snake husbandry problems as a service to the herp community.

For sale: **Northern Mexican pine snakes**, *Pituophis deppei jani*, as seen in the January 1997 *Reptiles* magazine, captive-born babies from a large, unrelated, locality-matched breeding group. The majority of *P. d. jani* in captivity originate from my stock. Care sheet included in every order. Alan Kardon, (210) 623-4311 after 6:00 P.M. Central Time.

For sale: expected '97 offspring. New Jersey coastal plains milksnake, sharp rust/orange, $50–250; anerythristic Hondurans, $1000, possible hets, $250; albino Florida garters, creamy yellow/white, nice, $300, hets, $150; albino plains garters (two bloodlines); albino Cal kings, lavender/white & gorgeous yellow with purple splotches, $300, hets, $150. Scott, (919) 934-0110. [NC]

For sale: Send SASE to CRC, P.O. Box 0731, Las Vegas NV 89125-0731 for brochures and list of species available. Limited bookings available for guided tours of herpetological collection sites in Nevada. Call/fax (702) 471-0240. E-mail <fpglwmau@anv.net>.

Herptile shows: **Repto-rama** — live educational presentations of local herps and herps of the eastern U.S. for parties, scout groups, nature centers etc. **Salamanderiffic** — live educational presentations and exhibits of the tailed amphibians of the U.S. for nature centers, scout groups, community centers, etc. For all age groups. Dave Golde, (847) 679-1530.

Pet-sitting service: Exotic pet-sitting by "The Lizard King," in-home care. CHS member since 1979. Marilyn Kent, (773) 989-4472.

Advertisements (cont'd)

Pet-sitting service: Complete in-home pet and plant care, specializing in reptiles and other unique pets. Dogs and cats welcome with open arms, midday dog walking. Experienced and dependable service by devoted animal lovers, serving Chicago and suburbs, reasonable prices, fully insured and bonded. Ask about our habitat consultation and custom-made cages. Exotics & More, (312) 728-5457 or page us at (708) 750-3688.

Software: **TRACS**™ record keeping and breeding software for IBM and compatibles. TRACS™ Professional, a full system, $129; TRACS™ *Lite*, for the hobbyist, just $39.95. Add $5 s&h, $10 outside U.S. Send for a working demo for $10 (cost may be applied toward purchase). Or download demo free via Internet at <http://www.herp.com/tracs/>. Send check or money order to Leapin' Lizards, 23852 Pacific Coast Highway, #375, Malibu CA 90265.

Tours: Adventure tours to Madagascar! Join **Bill Love** seeing and photographing fauna and flora, heavily herp-biased, across the world's least known mini-continent. Maximum fun & photo ops assured on every trip. Contact him at: BLUE CHAMELEON VENTURES, P.O. Box 643, Alva FL 33920. TEL: (941) 728-2390, FAX: (941) 728-3276, E-MAIL: <blove@cyberstreet.com>.

Tours: **Road-riding in Costa Rica!** Treat yourself to the trip of a lifetime! Learn about tropical herps, find them, photograph them, see where they live. **Greentracks, Inc.**, offers the best herpetological tours led by internationally acclaimed herpetologists and herpetoculturists. See the Amazon, visit cloud forests, experience the world's greatest rainforest, super sunsets and good company. Call (800) 9-MONKEY.

Wanted: male gliding gecko; male Bibron's gecko; female palm gecko; female tropical girdle-tailed lizard; female corn snake [known breeder]. Matt O'Connor, [630] 469-4533.

Wanted: subadult or adult rough-scaled sand boas (*Eryx conicus*). Chris Jackson, (619) 265-7557 phone/fax.

Wanted: big-headed turtles; mata mata turtles; Mexican giant mud turtles (*Staurotypus triporcatus*); exceptionally large common snappers (45 lbs. & up); large alligator snappers (over 90 lbs.); spectacled caiman from Trinidad, Tobago and Surinam; dwarf caiman; smooth-fronted caiman; albino turtles (except red-eared sliders). Walt Loose, (610) 926-6028, 9:00 A.M. – 1:00 P.M. or after 11:30 P.M. Eastern Time.

Wanted: person or business interested in brokering for moderate-sized reptile breeder. Troy, (573) 642-9422. [MO]

Wanted: Styrofoam boxes, any size or shape so long as they're not flimsy, preferably with cardboard liners, willing to pay from $2 to $5. Bring to CHS meetings. Scott J. Michaels, D.V.M, Serpent City, (815) 363-0290.

Line ads in this publication are run free for CHS members — $2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to: Michael Dloogatch, 6048 N. Lawndale Avenue, Chicago IL 60659, (773) 588-0728 evening telephone, (312) 782-2868 fax, E-mail <MADadder0@aol.com>.

News and Announcements

1997 CHS GRANT RECIPIENTS

The following individuals have been awarded CHS Herpetological Grants in 1997:

- **David Beamer**, Department of Biology, Indiana University Northwest. "Conservation of Turtle Diversity in Relation to Wetland Destruction and Restoration in Newton County, Indiana." Awarded $100.
- **Todd Campbell**, Department of Ecology and Evolutionary Biology, University of Tennessee. "An Experimental Analysis of Interactions between a Native and an Introduced Lizard Species Using Dredge Spoil Islands in Florida." Awarded $450.
- **Eli Greenbaum**, Department of Biology, Northeast Louisiana University. "Sexual Differentiation in Spiny Softshell Turtles (*Apalone spinifera*)." Awarded $250.
- **James N. Stuart**, Museum of Southwestern Biology, University of New Mexico. "Status of Introduced Populations of the Red-eared Slider (*Trachemys scripta elegans*) in the Rio Grande Drainage of New Mexico." Awarded $450.
- **Daniel A. Warner**, Iowa State University. "A Survey of a Northern Population of Six-lined Racerunners, *Cnemidophorus sexlineatus*." Awarded $250.
- **Lee A. Weigt**, Field Museum of Natural History, Biochemistry Labs. "Conservation Genetics of Golden and Harlequin Toads." Awarded $500.

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, June 25, at the Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, in Chicago. This will be our ever-popular annual Show & Tell meeting. Bring an animal that you find interesting for one reason or another and be prepared to give a short (under 5 minutes) presentation to the group. Don't be shy. Age (yours) or commonness (the animal's) should not be a limitation. Guidelines for the occasion, based upon previous experiences: please don't bring venomous reptiles or endangered species, and please bring only amphibians or reptiles (this means no worms, tarantulas or other invertebrates).

At the July 30 meeting Paul Freed of the Houston Zoo will speak and show slides about a herpetological collecting trip to the Cameroons, in West Africa. If you have ever wondered where all those ball pythons come from, here's your chance to find out.

We are required to use the entrance on the west side of the museum. We have permission to use the staff parking lot to the west of the museum. Entrance to this lot is from McFetridge Drive, the wide street just to the south, between the museum and Soldier Field. **Due to the recent rerouting of Lake Shore Drive, there have been some changes in traffic flow – follow the signs to the "Museum Campus." From southbound Lake Shore Drive this means a right turn onto Roosevelt Road followed by a left on Columbus Drive.** The Roosevelt Road (12th Street) bus now goes directly to the museum, thus providing a connection with the el and subway. This bus service runs until after 11 P.M.

Turtle Club

The Chicago Turtle Club will meet Sunday, June 22, 1:00–3:30 P.M., at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago.

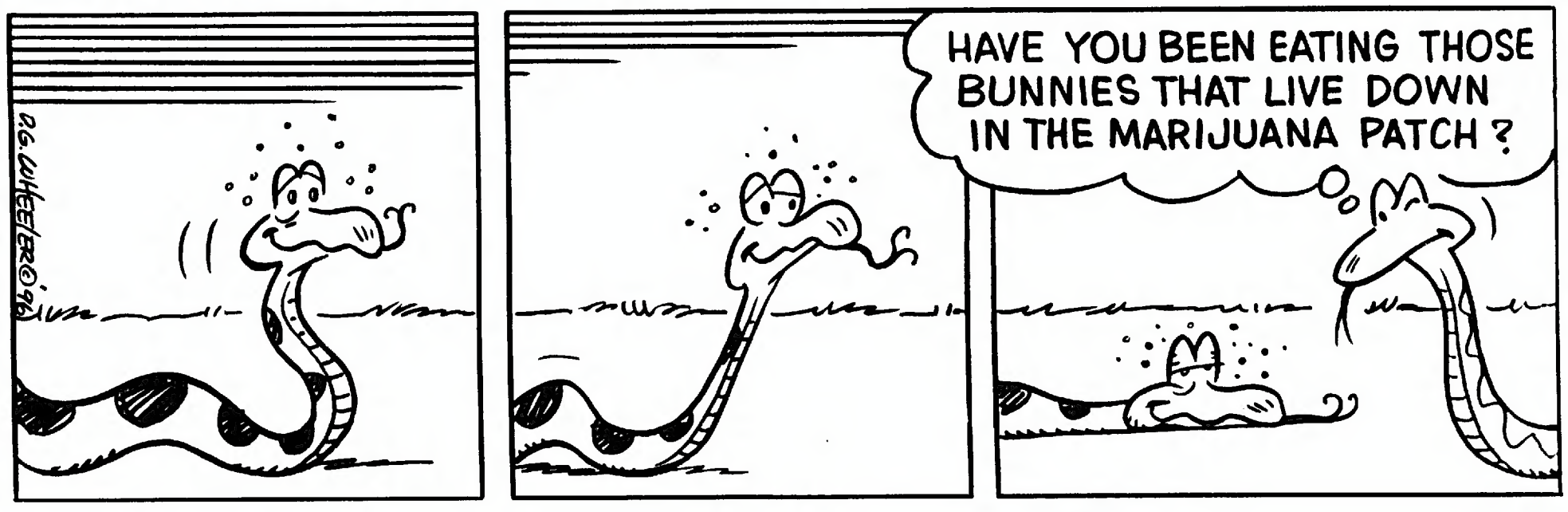
ATTENTION: EXCHANGE PUBLICATIONS

The Chicago Herpetological Society has a new mailing address. Those of you who have not already done so, please adjust your mailing records to include our new address: Chicago Herpetological Society, 2060 N. Clark Street, Chicago IL 60614. We will not receive your publications if you continue to send them to the old address.

MOVING??

Please let us know in plenty of time of any change in your mailing address. The *Bulletin of the Chicago Herpetological Society* is sent to our U.S. members by bulk-rate third class mail. This means that the U.S. Post Office will not forward your *Bulletin* with the rest of your mail. This is so even if you make a special request that your magazines be forwarded (such a request only applies to second class mail).

THE ADVENTURES OF SPOT



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